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JULY, 1934

1934

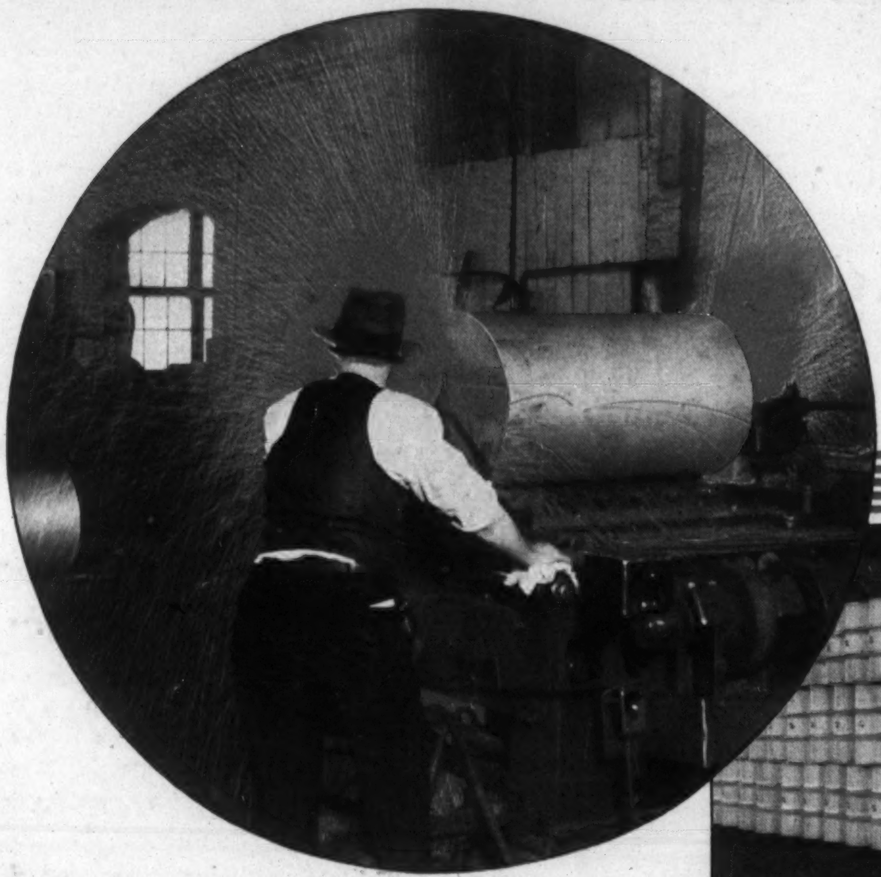
METALS & ALLOYS

The Magazine of Metallurgical Engineering

PRODUCTION · FABRICATION · TREATMENT · APPLICATION

Current Metallurgical Abstracts

WELDED STAINLESS STEEL CONTAINERS REPLACE WOOD FOR COCA·COLA



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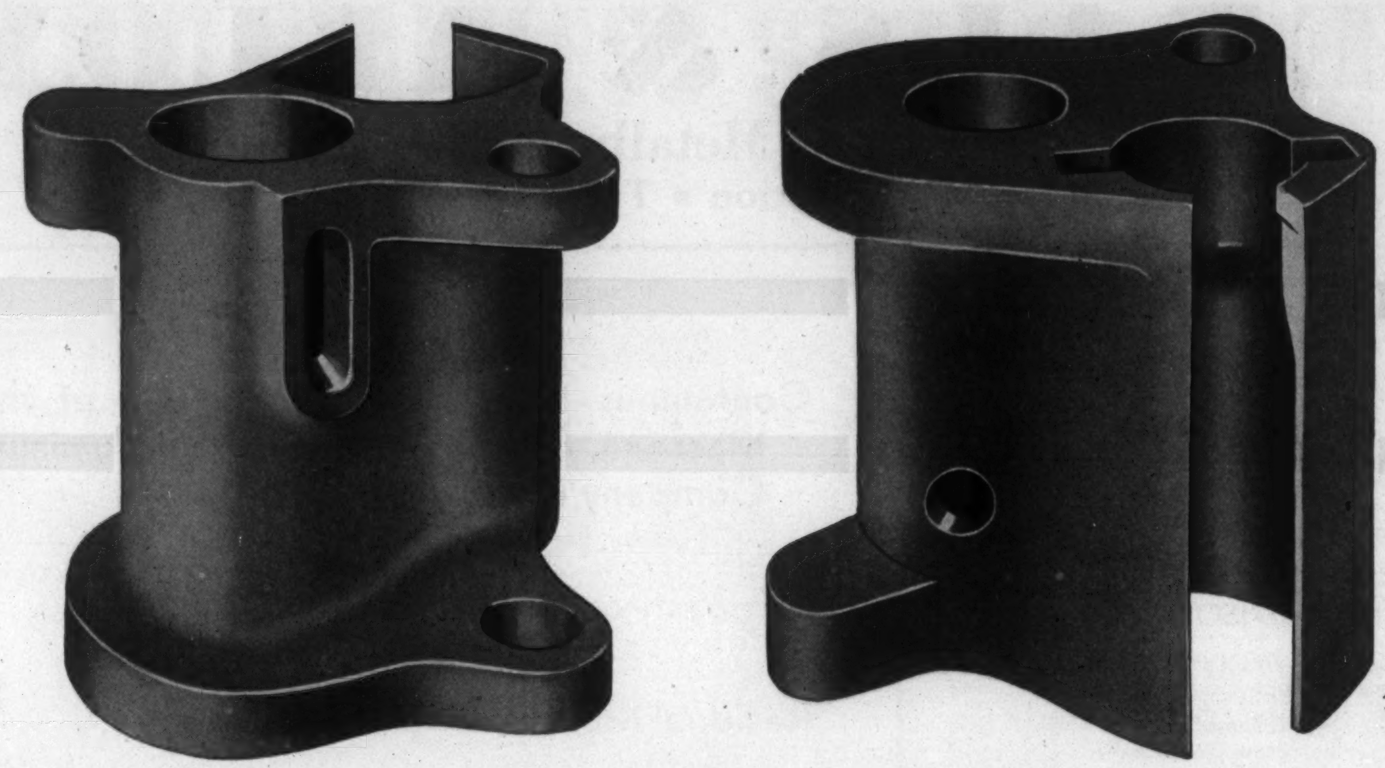

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The casting illustrated (2 views) is a part in a bottle-capping machine. It replaces a similar part made from another alloy and cast in sand. This sand casting required considerable machining. Not infrequently, defects in a casting were discovered only after much of the machining had been done, thus causing a waste of machining time.

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ALUMINUM BRONZE
STRONGER-THAN-STEEL
DIE CASTINGS

HIGHLIGHTS

by H. W. GILLETT

That's What We'd Call a Trace

Hillenbrand and Kenny (page MA 314 R3) study the possible presence of antimony in copper fire-refined to free if from arsenic and conclude that, if present, it can't be there in amount over 0.00001%.

"Drink Deep, or Taste Not the Pierian Spring"

Leitner (page MA 334 R1) says that plates to be arc welded with bare rimmed steel electrodes should either have no silicon or quite a lot of it, to avoid porous welds.

And Still More Books

Last month, twelve books were reviewed, this month, you will find reviews of the following: The Alfred David Lenz System of Lost Wax Casting (page MA 316 R1); Disturbances in the Operation of Acetylene Generators and How to Overcome Them (page MA 334 R2); The Metallurgy of Iron (page MA 356 R2); Alloys of Iron and Tungsten (page MA 356 R2); Recipes for the Machine and Metal Working Industries (page MA 372 R3); America Self-Contained (Page MA 372 R4).

Vacuum Melting

Wentrup (page MA 318 R1) reports that experimental vacuum melting of 20 lb. lots of steel shows that much deoxidation can be effected by carbon and inclusions due to solid deoxidation products minimized. As we've long argued that this should happen, corroboration seems important to us. Now for a large-scale demonstration.

Sounds Like the House that Jack Built

In melting aluminum in a reverberatory, says Richards (page MA 314 R1) if the metal is not oxidized, it does not absorb nitrogen and if it does not absorb nitrogen, it won't absorb CO_2. Maybe if it isn't hot enough to do one it isn't hot enough to do any.

DO YOU want to know what metallurgical engineers are saying, the world over? Look in the Current Metallurgical Abstracts. Here are some of the points covered by authors whose articles are abstracted in this issue.

Cumulative Index to the Current Metallurgical Abstracts

If true worth is determined by usefulness, the abstracts which appeared during 1932 and 1933 will unquestionably take on a new value with the appearance of the Cumulative Index for these years. The experience gained by the editorial staff in compiling the index for 1929-1931 will contribute toward making this issue of the Cumulative Index a comprehensive and serviceable work, an indispensable tool and a valuable aid to every engineer concerned with the production, fabrication, treatment and application of metals and alloys.

The index is comprised of two parts: 1. a complete subject index and 2. an author index (see page MA 338).

Place your order for the index immediately, only a limited number will be printed.

Beryllium

Beryllium is still of considerable interest as is evidenced by the number of articles abstracted: Beryllium in Copper (page MA 354 L4), Beryllium and Its Alloys (page MA 354 L8, page MA 355 R9), Silver and Beryllium (page MA 354 L9), Beryllium Heavy Metal Alloys (page MA 354 R1), Copper-Nickel-Beryllium (page MA 355 L3), and Beryllium Copper (page MA 355 R2).

Arsenic and Antimony in Cast Iron

Piwowarsky and coworkers (page MA 356 R1) study arsenic and antimony in cast iron, a little arsenic possibly improving the iron. More arsenic or the use of antimony wasn't very attractive.

Titanium Improves Machineability

Comstock (page MA 356 L9) and Brauer (page MA 356 L10) agree that titanium improves machineability in cast and malleable irons.

Testing of Welds

This month abstracts of three articles appear on the fatigue testing of welds: Fiek (page MA 347 L8), Peterson and Moore (page MA 348 L9), and Doussin (page MA 348 R6). Another article on magnetic testing of welds by Kieskalt appears on page MA 348 R10.

Internal Stresses

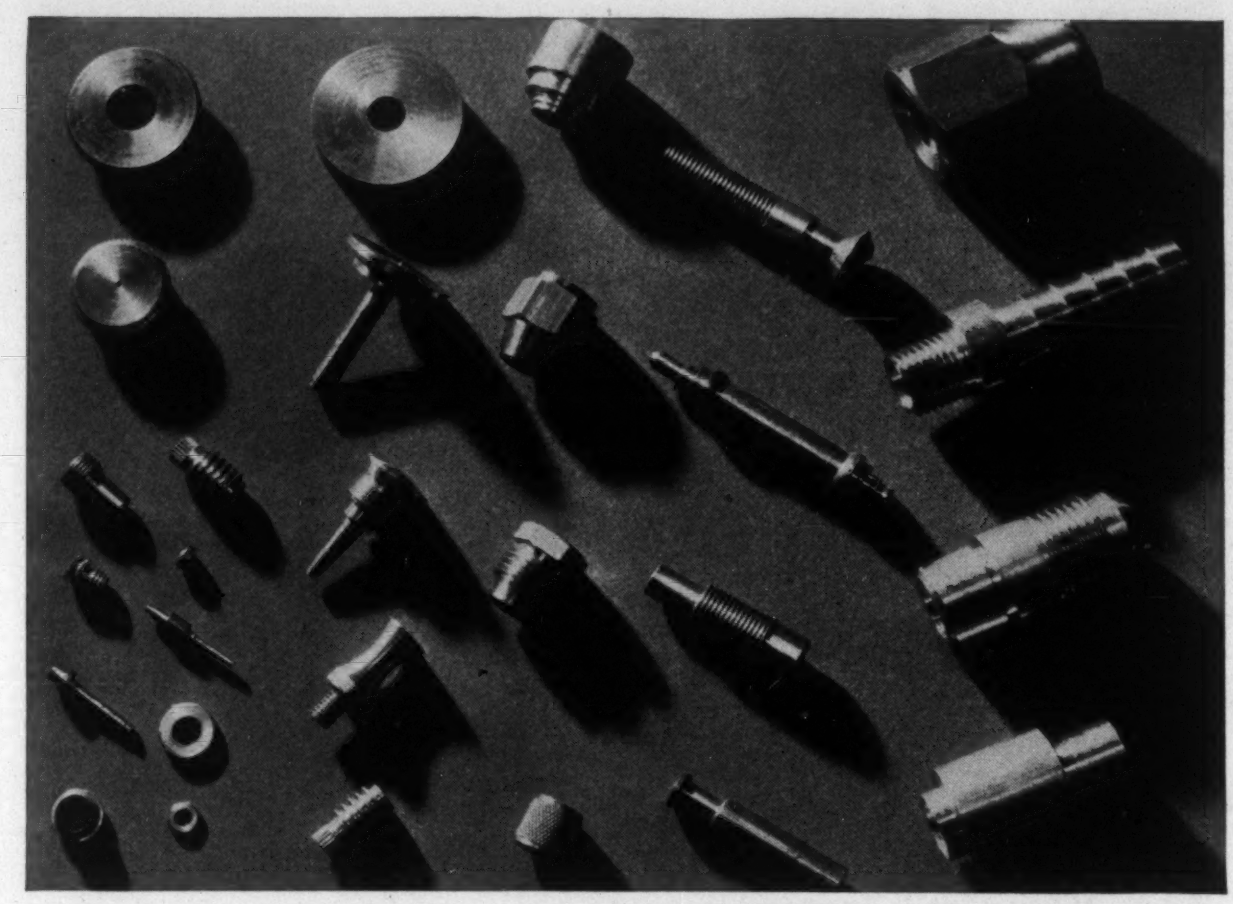
Buehler and Buchholtz (page MA 348 L1) agree with the usual conclusion that high internal stresses (when in tension and not in compression) at the surface of a part subjected to repeated bending, pull down the endurance limit, but think that such stresses, up to 20 kg./mm.^{2}, are released by local yielding under the influence of repeated stress in material of sufficient plasticity, and hence are not harmful.

Manufacturers' Literature

In this issue of *Metals & Alloys,* there appears an unusually large number of reviews of manufacturers' literature (pages MA 375 to MA 378). This department of *Metals & Alloys* is conducted for the convenience of the readers desiring to add to their files copies of the current literature issued by manufacturers. Any items desired can be secured free by applying direct to the issuing firms or in those cases where a number of items are wanted applications may be sent to *Metals & Alloys,* using the coupon provided on page MA 378.

Special Alloys

A number of trade marked alloys are covered in an article appearing in the *Zeitschrift für die gesamte Giessereipraxis* (page MA 352 L6).



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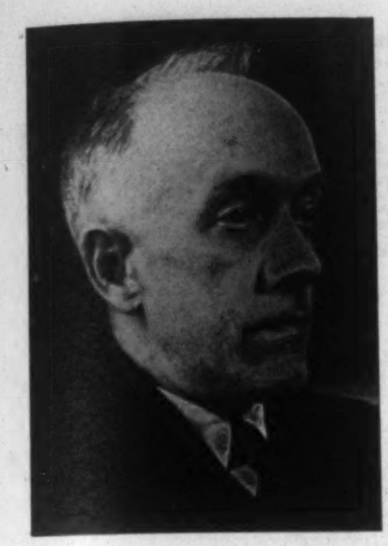

EDITORIAL COMMENT

The Time Factor

IN ENGINEERING, as well as in physiology, there is a period of gestation. Similarly, too, the period varies with the size and importance of the newborn idea just as it varies between the mouse and the elephant. As in physiology, the infant never has but a single parent, indeed the engineering infant normally has so many that the parentage is somewhat in doubt.

In looking up a reference on another subject in our elder contemporary, The Iron Age, we chanced upon a news note headed "Proposes Steel Substitute," under the date line of April 22, 1924, which stated that W. W. Atterbury of the Pennsylvania Railroad was supporting a bid for the Muscle Shoals power plant on the plea that the railroads would be forced to reduce the dead weight of their freight cars and that hence they must have cheap aluminum to replace steel.

Hence, it was not because of a lack of appreciation of the wastefulness of toting dead weight from one end of the country to the other or of any lack of faith in the satisfactory solution of the engineering problems involved that prevented the birth of actual light weight railway cars ten years ago. The conception was made well before that time.

In the intervening period, the demanded notable cheapening of aluminum did not occur, for the ratio of the then price of aluminum to the composite price of steel is not widely different from the ratio at the time we write. But a lot of other things have happened. The railroads have fallen into so serious a plight that they must do something. Passenger service losses are generally worse than freight losses and competing methods of transportation, by auto and plane have brought the necessity for greater speed.

The increased knowledge of the transverse fissure problems in rails has indicated that reduced wheel pressure on high speed trains will be helpful in that direction. Knowledge of stream-lining and its effect on speed brought out by aeronautic wind-tunnel research has shown the logic of aero-dynamic design combined with weight reduction. Attention has thus been centered upon passenger trains or special freight trains like those that carry silk, upon which money can be spent, leaving for later consideration the freight train and the problem of what to do with the old-type freight cars of other carriers that must be pulled for years to come.

Meantime, metallurgical progress has brought the production of large structural members of aluminum, intentionally worked out primarily for this use, of large heat-treated alloy steel castings for heavily loaded members, and also a lusty competitor of aluminum for parts of the car structure in welded stainless steel. Many other engineering developments have aided so that now we have several more or less experimental, but operable, pioneer light-weight high speed trains operating or about ready to operate. The parents of these infants are legion. That they will change and improve and multiply is of course plain, but they are born at last.

Smaller and less expensive things may take less time between conception and birth. The radio and the electric refrigerator, both expensive in respect to the total outlay for mass production, but relatively inexpensive per unit once in mass production, came into their own in a big way and with a rush because those who were convinced they wanted them could save up and buy one. Badly as the railroads may want to displace all the old freight cars with new light ones to run at high speed, the aggregate cost holds them back.

After the war, we expected that ere this the private airplane would be as common as the private automobile was then. The reason it isn't is because the airplane costs too much. Whether the suggestion of a $700 mass production plane bears fruit or not will take some time yet to determine.

At times it seems ludicrous how long it takes before an idea that is obviously sound advances to the point where we can buy the embodiment of the idea. Metallurgists ten years ago could confidently predict that a host of things would ultimately be made of stainless instead of rustable steel and that quantity production was in order. Only recently, however, have the tonnage steel groups accepted that fact, though patent problems to be ironed out were one of the deterrents in that case.

It was obvious long ago, when a closed car cost $300 more than a standard touring car, that the vast majority would prefer a closed car and that in quantity production no such differential was necessary. But it took one of the smaller producers who made the jump of offering a cheap closed car as standard to prove to the big boys that they had to do it too.

A tiny gadget that can be sold for a few cents or a few dollars can be made the vogue almost over night, or in a mouse's gestation period. But the big things that are complicated and demand simultaneous progress in many lines are more like the elephant.

Hence, some of the admittedly coming things, like air conditioning, summer cooling and fully automatic heating of individual homes, old as well as new, and rented as well as owned, which will utilize much metallic material, do not seem to us to offer as immediate a mass-production market as the metal producer might hope.

They will have to be brought to such a point of simplicity and reliability in construction, and installation and operation that their first cost is of a low order of magnitude. Or else the maker of such devices, and the seller of fuel to be used in them, must work out some

(Continued on page 160)

COCOANUT CAKE
4 Tablespoons Butter
1½ Cups Flour
1 Cup Sugar
2 Teaspoons Baking Powder
2 Eggs
1 Teaspoon Vanilla
½ Cup Milk

. . . *but* THESE ARE THE CAKES

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272

CARNEGIE *Controlled* STEELS

NITRICASTIRON*

By V. O. Homerberg** and D. L. Edlund***

THE APPLICATION of the nitriding process to certain steels to obtain a high surface hardness with a minimum of distortion is well known. The more recent application of this process to the case-hardening of cast iron has been confined almost entirely to centrifugally cast cylinder liners and similar articles.

The nitriding of special alloy cast irons has been discussed in pamphlets issued by Aubert and Duval Freres of Paris and in several articles by J. E. Hurst[1] of the Sheepbridge-Stokes Centrifugal Castings Company, Limited, of London.

The steels which are now being used commercially for nitriding contain as alloying elements aluminum, chromium, molybdenum and vanadium in varying amounts and in different combinations. The presence of aluminum is highly desirable since the aluminum nitride that is formed imparts maximum hardness to the steel when treated with ammonia within the recommended temperature range. Aluminum plays an additional role in cast iron since it is a marked graphitizing agent.

THE RESULTS of this investigation show that an aluminum-containing cast iron capable of being nitrided can be produced centrifugally and by casting in sand molds. Nitricastiron possesses excellent physical properties in the "As Cast" condition as well as after heat treating. It can be readily machined and after nitriding it exhibits properties that make it especially valuable for such applications as cylinder liners, bushings, cams and other parts that must possess good wear resistance.

Centrifugally cast cylinder liners are now being manufactured in this country by The Forging and Casting Corporation.† Although a number of compositions have been studied the present discussion is based on the results obtained on liners of the following composition:

Total Carbon	2.50	Molybdenum	0.60
Silicon	1.50	Aluminum	1.25
Manganese	0.60	Chromium	0.20

The charge of 250 lbs. was melted in an electric arc furnace to which was then added the ferro-molybdenum and the ferro-chromium. The metal was tapped into ladles of 20 lbs. capacity. The aluminum, in the form of rod cut into suitable sections, and cryolite were added to the ladle. The cryolite served to protect the metal from oxidation. The metal was cast centrifugally into liners having a

Two 40-Ton Powdered Coal Air Furnaces in the Foundry of the Hunt-Spiller Manufacturing Company

---

*Nitricastiron is the trade name given to the several varieties of cast iron capable of being case-hardened by certain nitrogen-containing materials such as ammonia.

**Associate Professor Physical Metallurgy at the Massachusetts Institute of Technology and Technical Director of The Nitralloy Corporation.

***Research Associate in Division of Physical Metallurgy, at the Massachusetts Institute of Technology.

[1] J. E. Hurst. Some Experiments on the Nitrogen-Hardening of Cast Iron. Journal of the Iron and Steel Institute, No. 1, 1932.

J. E. Hurst. Some Experiments on the Resistance to Wear of Nitrogen-Hardened Cast Iron. Journal of the Iron and Steel Institute, No. 2, 1933.

†The Forging and Casting Corporation of Ferndale, Michigan, is a licensee of The Nitricastiron Corporation.

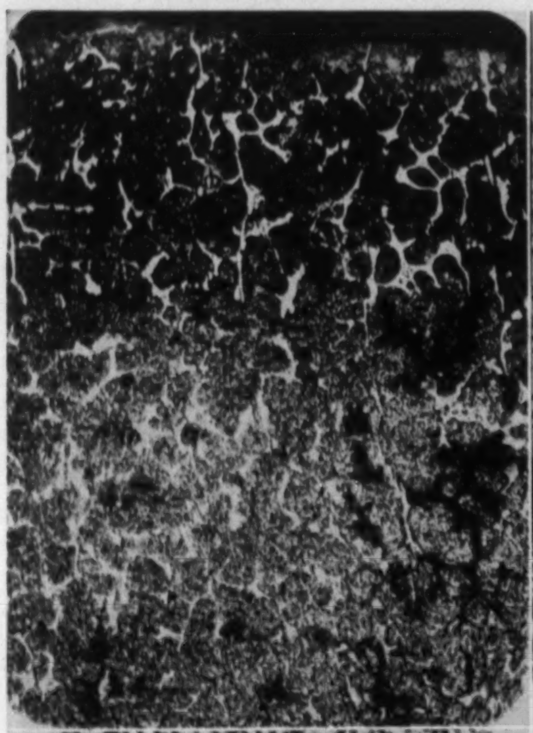

Fig. 1. Nitride case of centrifugally cast liner. Nital etch. .014″ case. Magnification 100x.

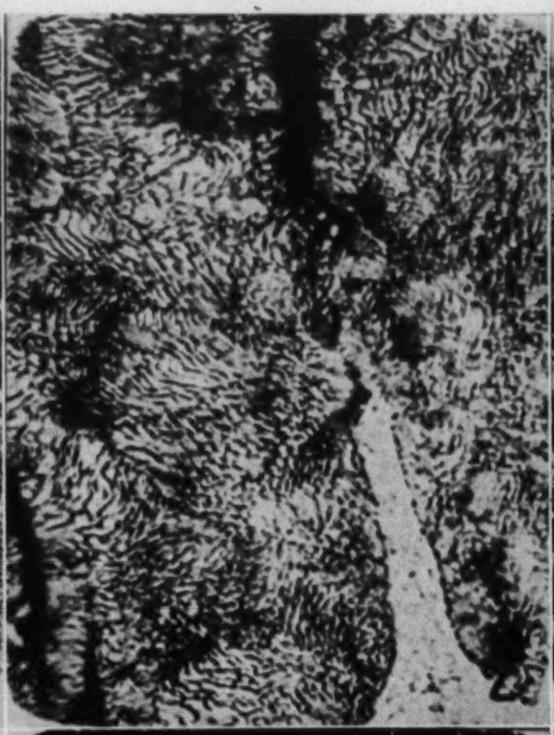

Fig. 2. As cast. Nital etch. Magnification 1000x.

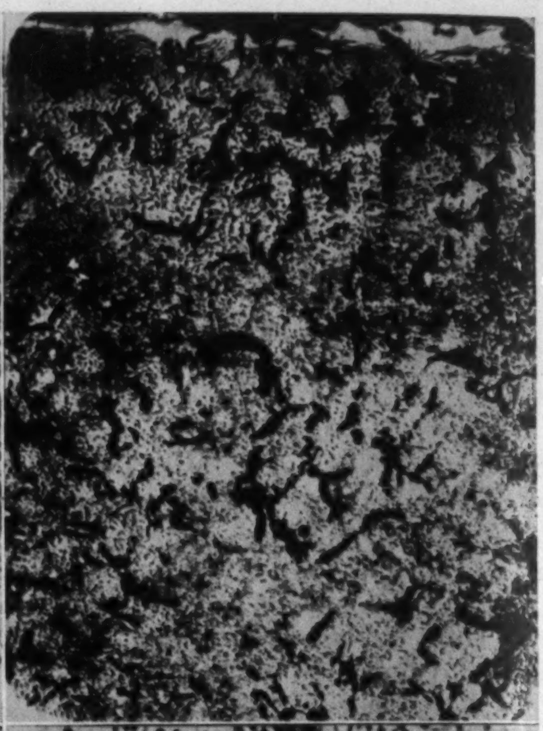

Fig. 3. Nitride case. .015″. Magnification 100x.

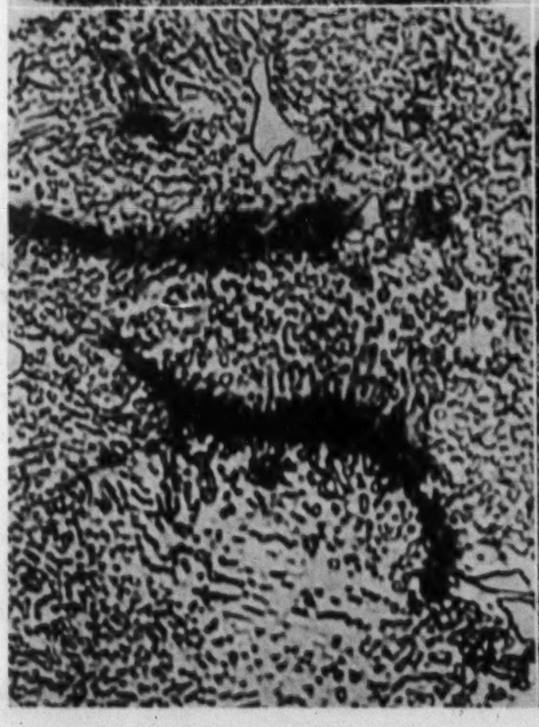

Fig. 4. Core structure. Magnification 1000x.

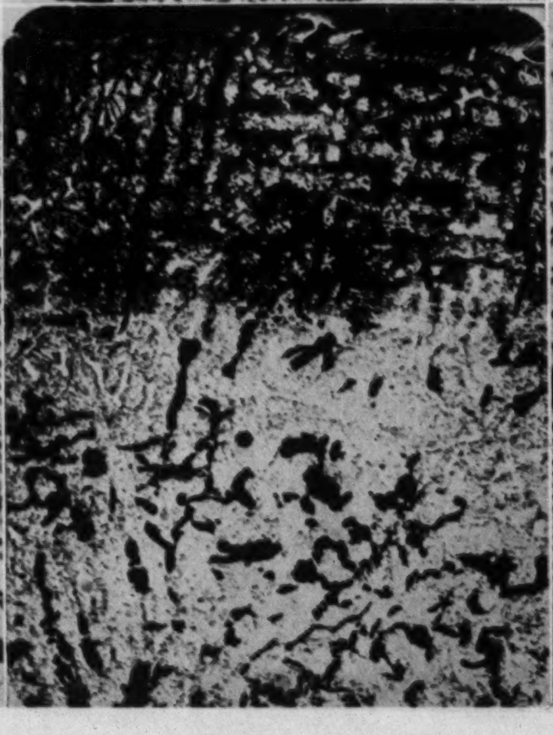

Fig. 5. Case depth .012″. Magnification 100x.

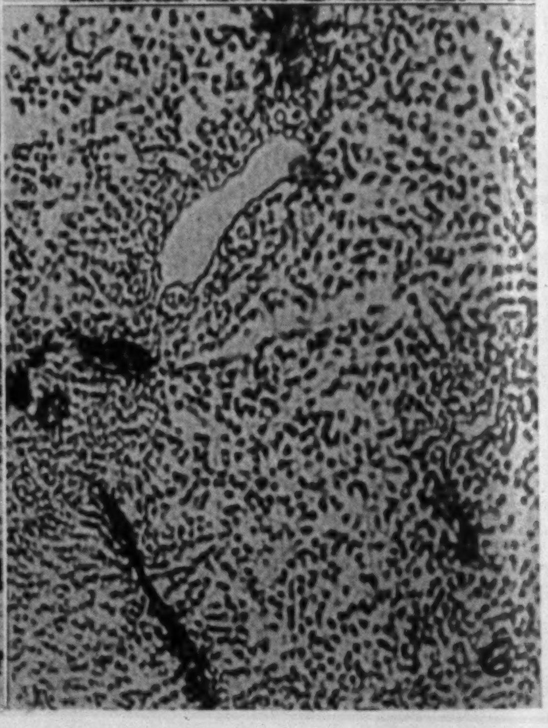

Fig. 6. Magnification 1000x.

wall thickness of approximately ½ inch. They were air cooled after which they showed a white or mottled structure with a Brinell hardness of 418.

The "As Cast" liners were put through the following series of operations to produce the finished product:

(a) Heated at 1650°F., for 1 hour and quenched in oil. Drawn at 1400°F. for 1 hour.
(b) Rough machined.
(c) Drawn at 1100°F. for 6 hours to relieve machining stresses.
(d) Nickel plated all over.
(e) Inside bored to proper diameter.
(f) Nitrided at 980°F. for 60 hours.

No difficulty was experienced in machining. The nitride case of a liner treated in this manner showed a Rockwell N hardness of 79 when tested with the Rockwell Superficial Hardness Tester under a 30 kg. load. The case depth was 0.014 inches. No chipping of the case took place, although short radial cracks were produced around the impressions. The hardness approaches that obtained for Nitralloy which gives values from N80 to N85.

The Brinell hardness of the core after this heat treatment was 235. Higher hardness values can be obtained by using a lower tempering temperature. The structure of the "As Cast" material is white to mottled. The heat treatment converts some of the excess carbide to temper carbon and the matrix from pearlite to sorbite or to a finely spheroidized structure.

Air cooling from 1750°F. followed by tempering at 1350° to 1400°F. produces a similar structure.

The nitride case is shown in Fig. 1.

It is desirable to protect the outside surface of the liner. Instead of nickel-plating, other protective agents may be used such as tin, solder, tin oxide plus glycerin, etc.

The sand casting of cast iron containing aluminum represents a more difficult problem than that encountered in making articles by the centrifugal method. Aluminum oxidizes very readily and forms a tenacious oxide scum on the surface of the metal. When this metal is cast, the scum breaks during the pouring operation and fragments of this oxide layer become entrapped in the casting thereby rendering it worthless. A viscous slag is also produced.

It is obvious that the successful manufacture of sand castings will greatly increase the number of applications for Nitricastiron. It was with this aim in view that a coöperative arrangement was made with the Hunt-Spiller Corporation for an intensive research involving this problem. The authors wish to acknowledge their indebtedness to R. F. Harrington and his metallurgical associates as well as to the executives of this company for their excellent coöperation in the successful solution of this problem.

A 250 lb. oil fired crucible furnace of the Monarch type was used for the experimental production of various compositions of Nitricastiron for sand casting.

Freedom from a viscous slag and the elimination of the tenacious scum were overcome by the addition of cryolite, a double fluoride of aluminum and sodium (AlF_3, $3\ NaF$), to the ladle. The aluminum and the chromium were added to the crucible, the former shortly before pouring, while the addition of the molybdenum was made to the ladle.

Larger experimental melts were made by using two crucible furnaces or by making alloy additions in the ladle to iron from an air furnace.

Cryolite is an excellent solvent for aluminum oxide and protects the melt until it enters the mold. In order to procure sound castings it is necessary to cause the metal to enter the mold quietly in order to prevent as far as possible the rupture of the oxide film that is produced on the surface of the metal when it becomes exposed to the air in the mold. If this precaution is taken the oxide layer will be confined to a shallow depth on the surface of the casting and is readily removed by machining prior to nitriding. Bottom pouring with a gradual increase in the diameter of the gate is advisable in order to procure satisfactory results.

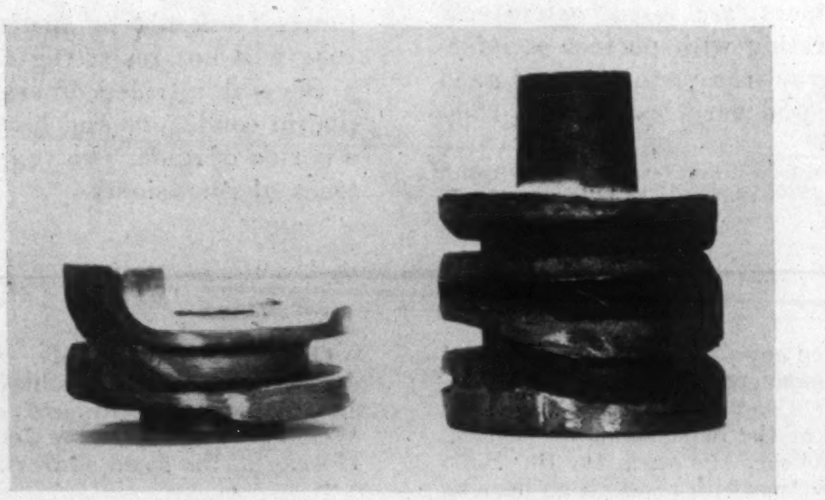

Fig. 7. Cams made by sand casting. 1/5 actual size.

Tyson[2] investigated the heat treatment and the nitriding characteristics of a number of alloy cast irons containing aluminum, molybdenum and chromium in various combinations. As a result of his investigation and subsequent experiments, an alloy cast iron of the following approximate composition was adopted for this part of the investigation.

Total Carbon	2.90	Manganese	0.60
Combined Carbon	1.00	Aluminum	1.00
		Molybdenum	0.75
Silicon	1.60	Chromium	0.40

An alloy cast iron, the composition of which is given in Table 1, was cast into 1¼ inch diameter transverse test bars 15 inches long. The test bars were broken on supports 12 inches apart. The physical properties of the material in the "As Cast" condition and after heat treating are also included in the table.

Specimens of the test bars were nitrided at 975° F. for 60 hours in a Leeds & Northrup Homo nitriding furnace. The depth of case was determined microscopically.

The microstructures are shown in Figs. 2 to 6 inclusive. Fig. 2 shows the core structure at 1000X of the "As Cast" material. The matrix is pearlite with islands of free carbide together with small and well distributed graphite flakes. Fig. 3 shows the nitride case at 100X and Fig. 4 the core structure at 1000X of the material after air cooling from 1750° F. followed by tempering at 1350° F. The matrix shows very finely spheroidized carbide particles. The structure of the oil quenched and tempered specimen is similar to that of the air-cooled material. The nitride case is shown in Fig. 5 and the core structure in Fig. 6.

Two cams, 2½ in. and 7½ in. in height weighing 12 and 25 lbs. respectively, are shown in Fig. 7.

Hardness of Nitricastiron

The true hardness of the nitride case on Nitricastiron, especially when sand cast, cannot be determined by any of the practical hardness testing machines. The presence of graphite tends to produce low results. The high Vickers hardness given by Hurst is due to the fact that the combined carbon in the centrifugally cast material is high due to the rapid cooling in the mold.

The value of the file test is also questionable. Since many other factors besides hardness enter into the problem of wear resistance, only service tests can furnish accurate data.

Growth on Nitriding

Articles increase slightly in size on nitriding. This growth is dependent mainly on the temperature and the time of nitriding. The amount of growth is quite constant under the same conditions, so that after it has once been determined for a given material or article it can be allowed for in the final machining or grinding or it can be removed by lapping or careful grinding of the nitrided part.

An increase in diameter of 0.002 inch in a specimen having a case depth of 0.030 inch serves as a fair example of the extent of this growth in Nitralloy. Lieutenants Hubbard and Robinson[3] found that Nitricastiron showed a growth about 50% greater than that exhibited by the various nitridable steels.

In the case of hollow cylinders, a variation in the internal growth will be noted. This variation is apparently controlled by the thickness of the surrounding metal. The tendency of the bore to expand decreases as the thickness of the wall increases. This fact serves to emphasize the necessity for determining experimentally the

Table I

Heat Treatment	T.C.	C.C.	Mn	Si	P	S	Al	Mo	Cr	Transverse Strength	Deflection	Brinell Hardness	Tensile Strength	Case Depth
As Cast	2.97	1.00	0.58	1.54	0.27	.065	1.01	0.73	0.36	5380	0.11	270	51000	0.011
Heated at 1750°F. for 1 hour, air cooled, reheated at 1350°F. for 1 hour	2.90	0.88								6100	0.14	230	51200	0.015
Heated at 1650°F. for 1 hour, oil quenched, reheated at 1350°F. for 1 hr.	2.93	0.93								5750	0.12	230	55500	0.012

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[2] J. D. Tyson. A Study of Nitrided Cast Iron. Master's Thesis, M.I.T. 1933.

[3] H. E. Hubbard and J. M. Robinson. Investigation of Nitriding Steels and Their Application for Use in Torpedoes. Master's Thesis, M.I.T. 1934.

growth for a given article, after which proper allowances can be made since this growth will be practically constant under the same conditions.

Abrasion and Wear Resistance of Nitricastiron

The wear testing machine that was used in this test has been described by Homerberg and Walsted.[4] In principle the machine operates so that two flat specimens, 2 in. × 1 in. × ½ in. may be rubbed against each other under the desired load. The bottom specimen moves while the top one is stationary and is loaded by an adjustable weight. The machine was run at approximately 250 strokes per minute with an average pressure of 120 lbs. per sq. in. The Nitricastiron specimens were ground on emery belts Nos. 80 and 120 after which they were nitrided for 60 hours at 975°F.

Nitricastiron against itself showed only slight scoring without metal pick-up after 100,000 strokes. When Nitricastiron was used against un-nitrided material, the latter was badly scored after 2,000 strokes, whereas the surface of the former became smooth and was unaffected.

Nitricastiron cylinder liners are used extensively abroad where they are operating with perfect satisfaction in conjunction with a gray iron piston ring of good quality. Such a cast iron scored very badly after 1000 strokes when run against Nitricastiron in the test described above. It is evident, therefore, that this test is a severe one since it is run without lubrication. Under the same conditions, Hubbard and Robinson found that Nitricastiron operated successfully against nitrided Nitralloy. The presence of graphite, which serves as a lubricant, along with the hard nitride case makes Nitricastiron an excellent wear-resisting material. The authors are aware of the fact, however, that the results of wear tests have proper significance only when run under conditions that simulate service operations.

Corrosion Resistance

It is well recognized that the nitride case possesses marked resistance to certain types of corrosion, particularly atmospheric, water and salt water corrosion. Tyson found that this is not only true for the nitridable steels (Nitralloy) but also for Nitricastiron. He exposed specimens to the action of a 20% salt spray for 100 hours.

It should be emphasized that the nitride case in Nitricastiron should be left untouched as far as possible where resistance to corrosion is of paramount importance. It should be further emphasized that the nitride case will not resist the action of acids.

Several nitrided liners have been exposed to atmospheric conditions and have been frequently handled over a period of about two years without showing the slightest trace of corrosion.

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[4] V. O. Homerberg and J. P. Walsted. Wear Resistance of Nitrided Nitralloy. *Metal Progress,* Vol. 18, 1930, pages 68-71.

Dr. Francis Lamb has just been appointed as spectro-analyst at the Michigan Smelting & Refining plant of the Bohn Aluminum & Brass Corporation. Dr. Lamb has for some time been assistant to Prof. Ewing, head of the department of physical chemistry at Michigan State College. His work for the Bohn company will be largely in connection with research on bearing materials. It has been reported that interesting announcements concerning new bearing materials will soon be made by the Bohn company. The new materials are particularly adapted for the increased loads and speeds found in modern automobile engines.

The appointment of **D. A. Nemser** as development engineer, with headquarters in Hartford, Conn., was announced by Dr. J. F. Thompson, vice-pres. of the International Nickel Co., Inc. Mr. Nemser was for 10 years associated with the metallurgical staff of Pratt & Whitney Manufacturing Company, occupying the position of chief metallurgist for the last five. During that time he exercised metallurgical control over the production of their entire line of products, embracing machine tools, small tools, gages and aircraft engine parts, and supervised gray iron foundry practice. In his new capacity Mr. Nemser will work with manufacturers throughout the New England territory on problems involving the selection, heat treatment and utilization of nickel alloy steels, nickel cast irons and other alloys containing nickel; placing at the disposal of these manufacturers not only his own metallurgical experience, but also the broad experience of The International Nickel Co., Inc., with a great variety of manufacturing problems.

Appointment of Railey & Milam, Inc., 27-39 W. Flagler St., Miami, Fla., as distributors of Enduro Stainless Steel and Toncan Iron, has been announced by N. J. Clarke, Vice-President in Charge of Sales, Republic Steel Corporation, Youngstown, Ohio. Mr. Clarke has also announced the appointment of the Ohio Valley Hardware & Roofing Co., Evansville, Ind., as distributors of Toncan Iron.

Appointment of Pidgeon-Thomas Iron Co., Iowa at South Main Street, Memphis, Tenn., as distributor of Enduro Stainless Steel has been announced by N. J. Clarke, Vice-President in Charge of Sales, Republic Steel Corporation, Youngstown, Ohio.

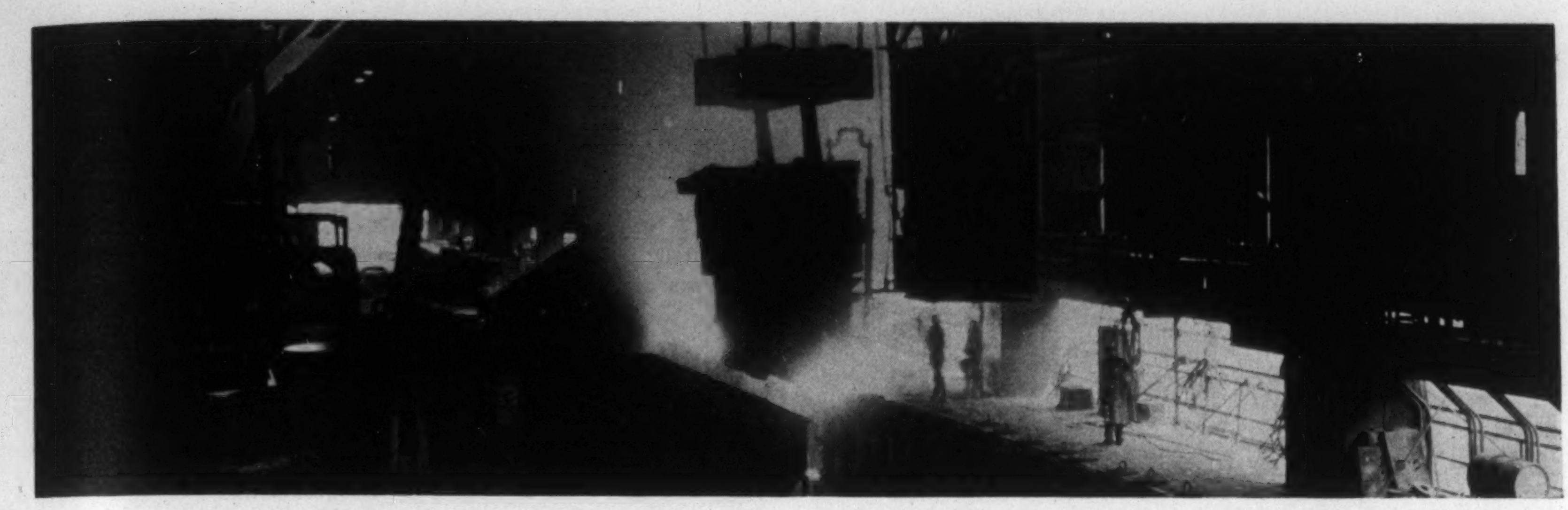
On April 10, 1934, Mr. E. D. Bransome of Rumson, New Jersey, effected the purchase of all Electrode Coating Patents and Methods therefor, etc., from the Electric Arc Cutting & Welding Company of 152 Jelliff Ave., Newark, N. J., and C. J. Holslag of the same address.

A contract for a planetarium dome of stainless steel, the largest in the United States, was awarded the Edward G. Budd Manufacturing Company today for the Hayden planetarium being erected in New York City by the American Museum of Natural History. The dome will be seventy-five feet in diameter, ten feet larger than that of the Fels planetarium in Philadelphia which was the first to use a metal dome.

Train service that will cut present schedules nearly in half and link cities a thousand miles apart by over-night railroad travel is to be the next important development of American railroads, according to Edward G. Budd, who built the stainless steel, stream-lined Zephyr for the Burlington Railroad.

That overnight service between such points as New York and Chicago and New York and St. Louis is not only possible but an early probability was demonstrated by the dawn-to-dusk run of the Zephyr from Denver to Chicago, Mr. Budd said. That run of 1,017 miles was made in 13 hours, at an average speed of 78 miles an hour and a total cost of $14.88 for fuel oil for the Diesel motors. The regular running time for a crack steam train is approximately 26 hours and the coal consumed costs $255.

A graduate fellowship for research study in some field of metallurgy connected with aluminum has been established at the Carnegie Institute of Technology by the Aluminum Company of America, it has been announced by Dr. Thomas S. Baker, president of Carnegie Tech. The fellowship, which is to run two years, will be awarded to a graduate student to be selected by Dr. R. F. Mehl, director of the metals research laboratory, under whose guidance the study will be made. The grant, which becomes effective September 1, will make it possible for the recipient to devote his full time to an investigation of a problem to be assigned by the Institute. The fellow will conduct his studies in the metals research laboratory where fundamental research in metals is being done at the present time by a group of experts.



Courtesy Youngstown Sheet & Tube Company

Residual Metals in OPEN HEARTH STEEL

by John D. Sullivan*

IN OPEN HEARTH steel the presence of residual metals that come from scrap has been a source of much concern to steel plant operators. Owing to the use in basic open-hearth charges of alloy-steel scrap and other scrap containing appreciable quantities of alloy constituents, the amounts of some of these adventitious elements in basic open-hearth steel have been gradually increasing.

At times, difficulties in rolling the steel or in working the finished products have cast suspicion on some of these residual metals. On the other hand, improved qualities have sometimes been thought to result from the presence of one or more of these elements. Whether they are detrimental or helpful, it is, at any rate, desirable to know their amounts and the trend of any changes in those amounts.

Most of the foreign metals introduced into the basic open-hearth charge through scrap are partly or wholly recovered in the steel. Copper, nickel, and tin are virtually wholly recovered. Some of the vanadium and much of the molybdenum remain in the steel. Some chromium is always recovered although definite information is not available as to the percentage recovery when various amounts are present in the charge.

It is evident, therefore, that these residual metals will increase in open-hearth steel as increasing amounts of alloyed and coated steel are made and returned as scrap. In order to appraise the amount of these metals normally present in ordinary steel, and the rate at which they are increasing, the matter has been studied for several years.

In previous articles,[1] residual metals in open-hearth

Table 1. Residual Metals in Open Hearth Steel, March 1931—January 1934, Inclusive

Plant No.	%Ni				%Cu				%Sn				%Mn				%Cr			
	1931 Mar.-July	1931-32 Aug.-Jan.	1932-33 Feb.-Jan.	1933-34 Feb.-Jan.	1931 Mar.-July	1931-32 Aug.-Jan.	1932-33 Feb.-Jan.	1933-34 Feb.-Jan.	1931 Mar.-July	1931-32 Aug.-Jan.	1932-33 Feb.-Jan.	1933-34 Feb.-Jan.	1931 Mar.-July	1931-32 Aug.-Jan.	1932-33 Feb.-Jan.	1933-34 Feb.-Jan.	1931 Mar.-July	1931-32 Aug.-Jan.	1932-33 Feb.-Jan.	1933-34 Feb.-Jan.
A	0.039	0.063	0.109	0.074	0.025	0.045	0.051	0.061	0.004	0.003	0.004	0.004	0.22	0.24	0.23	0.21	0.048	0.031	0.040	0.040
B	0.021	0.024	----	0.013	0.022	0.044	----	0.059	0.007	0.008	----	0.007	0.23	0.23	----	0.39	0.024	0.019	----	0.008
C	0.043	0.054	0.054	0.033	0.097	0.215	0.218	0.150	0.017	0.025	0.034	0.016	0.11	0.11	0.10	0.12	0.020	0.019	0.028	0.029
D	0.029	0.035	----	0.070	0.104	0.053	----	0.173	0.011	0.008	----	0.019	0.21	0.24	----	0.27	0.030	0.019	----	0.041
E	0.089	0.071	0.055	0.050	0.268	0.296	0.193	0.234	0.035	0.041	0.021	0.028	0.11	0.24	0.12	0.12	0.052	0.036	0.033	0.038
F	0.032	0.072	0.057	0.057	0.106	0.080	0.080	0.114	0.014	0.013	0.014	0.013	0.15	0.16	0.14	0.16	0.031	0.026	0.029	0.030
G	0.041	0.037	0.037	0.029	0.030	0.015	0.015	0.040	Nil	0.003	0.005	0.004	0.35	0.46	0.42	0.38	0.044	0.038	0.040	0.038
H	0.071	0.060	0.062	0.052	0.075	0.077	0.097	0.101	0.011	0.017	0.012	0.014	0.12	0.11	0.10	0.12	0.029	0.030	0.028	0.030
I	0.008	0.030	0.027	0.023	0.059	0.074	0.069	0.077	0.008	0.006	0.005	0.009	0.10	0.08	0.06	0.08	0.012	0.012	0.013	0.012
J	0.021	0.038	0.041	0.161	0.049	0.062	0.050	0.041	0.003	0.006	0.006	0.004	0.27	0.48	0.22	0.24	0.021	0.021	0.021	0.025
K	0.019	0.031	0.049	0.036	0.076	0.084	0.120	0.104	0.008	0.012	0.014	0.011	0.12	0.13	0.14	0.14	0.025	0.011	0.025	0.035
L	0.053	0.039	0.048	0.030	0.075	0.077	0.083	0.094	0.007	0.006	0.013	0.014	0.26	0.24	0.27	0.24	0.033	0.022	0.027	0.032
M	0.039	0.034	0.042	0.062	0.117	0.085	0.098	0.099	0.008	0.009	0.010	0.008	0.25	0.24	0.20	0.19	0.023	0.006	0.010	0.022
N	0.041	0.040	0.043	0.017	0.065	0.113	0.085	0.115	0.008	0.008	0.011	0.010	0.16	0.16	0.14	0.17	0.034	0.031	0.034	0.027
O	0.063	0.083	0.068	0.077	0.202	0.215	0.182	0.269	0.020	0.017	0.018	0.025	0.19	0.18	0.18	0.19	0.049	0.036	0.041	0.041
P	0.082	0.107	0.087	0.079	0.088	0.138	0.122	0.098	0.009	0.015	0.017	0.011	0.24	0.24	0.23	0.25	0.049	0.030	0.038	0.034
Q	0.057	0.050	0.047	0.047	0.122	0.114	0.116	0.129	0.021	0.022	0.018	0.023	0.25	0.23	0.21	0.21	0.049	0.046	0.045	0.039
R	0.063	0.044	0.060	0.051	0.040	0.032	0.061	0.082	0.005	0.004	0.008	0.008	0.26	0.31	0.30	0.31	0.021	0.021	0.023	0.029
S	----	----	0.039	0.030	----	----	0.056	0.077	----	----	0.007	0.007	----	----	0.32	0.36	----	----	0.030	0.040
T	----	----	0.036	0.032	----	----	0.054	0.059	----	----	0.006	0.005	----	----	0.28	0.32	----	----	0.028	0.028
U	----	----	0.040	0.043	----	----	0.058	0.058	----	----	0.007	0.006	----	----	0.07	0.07	----	----	0.022	0.027

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*Battelle Memorial Institute, Columbus, Ohio.

[1] Clyde E. Williams and John D. Sullivan. Residual Metals in Open-Hearth Steel. *Metals & Alloys,* Vol. 3, 1932, page 240.
Clyde E. Williams and John D. Sullivan. Residual Metals in Open-Hearth Steel. *Metals & Alloys,* Vol. 4, 1933, page 151.

steel were discussed and analyses were presented of samples from various steel companies in the United States and Canada. As was stated in former articles, samples are taken from representative heats before alloy additions are made. At the end of the month, composite samples of these are made and sent to Battelle Memorial Institute. Here, quarterly, semi-annual, or annual composites are made for analysis. For the past 2 years, the composite samples have been made annually. The collection of samples and making of analyses go on from year to year. This report brings the results up to date.

In Table 1, results are reported from March 1931 to January 1934, inclusive. A normal annual tonnage capacity of 8,600,000 tons is represented by the 21 plants coöperating in the current period.

Nickel, copper, tin, chromium, and manganese determinations were made. Manganese is a residual metal although it is purposely added to the charge, principally in the pig iron, so as to finish the heat with a given residual manganese content. Since the first paper of this series showed that the amounts of arsenic, lead, molybdenum, vanadium, and zinc present as residual metals were 0.001% or less, analyses were not made for these elements during the last period.

Fig. 1 shows graphically the average percentage of residual metals from all plants from December 1929 to January 1934 inclusive. Results are given for the arithmetic mean of all plants and also for the weighted average based on normal annual tonnage capacity. In Fig. 2, results are given for the 10 plants that have coöperated in all periods since this investigation started. In the figures the year is plotted as the middle of the period represented.

The average of all plants, by tonnage capacity, shows a marked increase over the previous period for manganese, a slight increase in chromium, a slight decrease for nickel and tin, with copper remaining constant. The average, by plants, shows increases for manganese, copper, and chromium, a decrease in nickel, with tin remaining constant.

The average, by tonnage capacity, of the 10 plants that have coöperated in all 7 periods shows an increase for copper and chromium, a decrease for nickel and tin, with manganese remaining constant. In the same 10 plants the average, by plants, shows identical trends as the average by tonnage capacity.

In general, the data presented in Figs. 1 and 2 show no marked changes over the previous period except for manganese, and as previously stated, this constituent is purposely added to the charge. Data in Table 1 show, however, that changes in individual plants in some instances were quite marked.

In the former papers, curves were given to show the variation in the amount of steel scrap used in different years and to permit comparison of this with prices, production rates, and the amount of residual metals present. Statistics are not available for basic pig iron production in 1933, so it is not possible to calculate the percentage of scrap used in open-hearth steel manufacture during last year.

The study of residual metals in open-hearth steels is being continued.

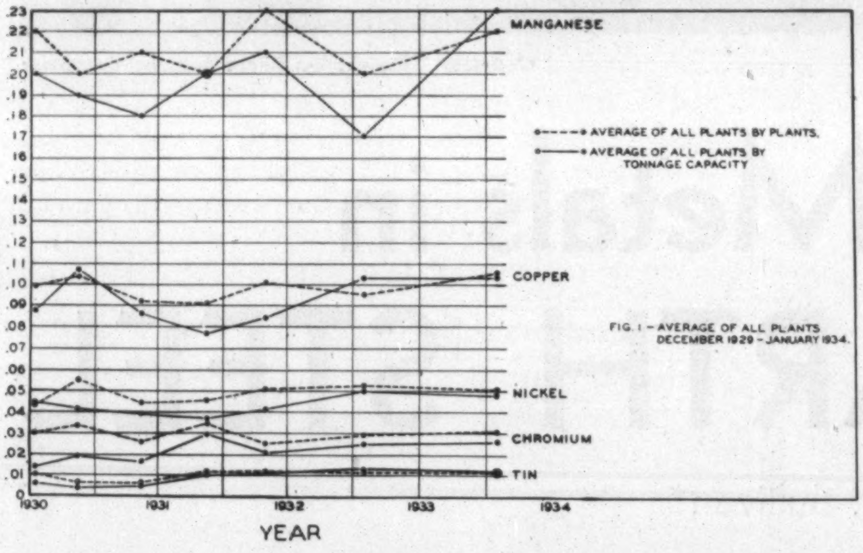


Fig. 1.

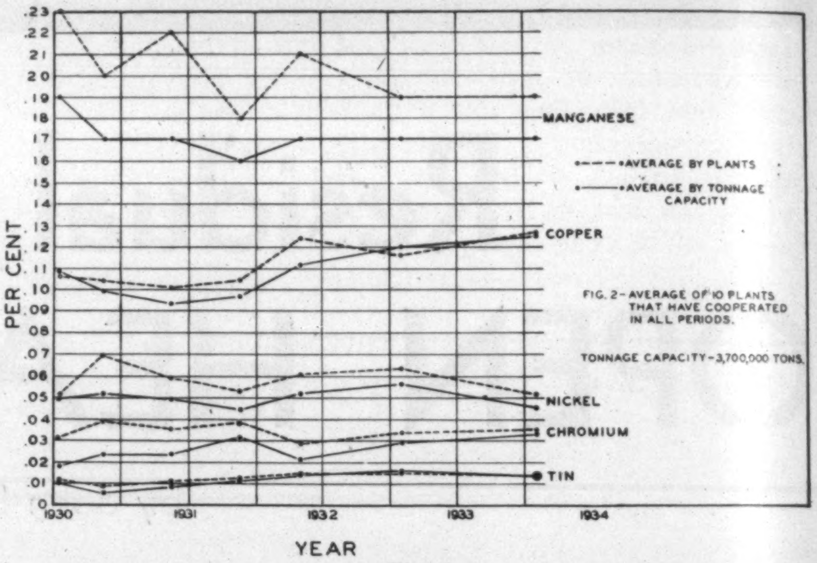


Fig. 2.

Courtesy Youngstown Sheet & Tube Company

Development of "Y" Lacquer

By Robert W. Belfit*

No. 5 in a series of Case Histories in Metallurgical Research

BEFORE the War the purpose of lacquer for metals was very often merely to protect the metal surfaces from tarnishing by sulphur fumes or from discoloration through oxidation by the air. In those days some manufacturers frankly stated that the only object of a lacquer coating was to protect the article until it reached the customer's hands. The public today, however, is far more exacting in its demands, and insists upon a coating which is strong, tough and highly resistant to abrasion and relatively permanent, as well as resistant to discoloration.

In addition to those characteristics, some of the customers of the Scovill Manufacturing Company desired a lacquer that would be practically odorless and colorless and resist exposure to alcohol, alkalies and perspiration. Other requirements may be imposed, for instance, cosmetic containers hold perfume bottles or are apt to come in contact with perfume containing alcohol, so that the usual nitrocellulose (cotton) lacquer becomes softened and then easily rubs off, and its protection against discoloration removed. To meet these needs the Scovill laboratories developed a lacquer termed "Y-lacquer," which, with its sub-formulae, successfully solved the problem. The development of the lacquer may be taken as a rather representative example of a research problem carried out under favorable environment.

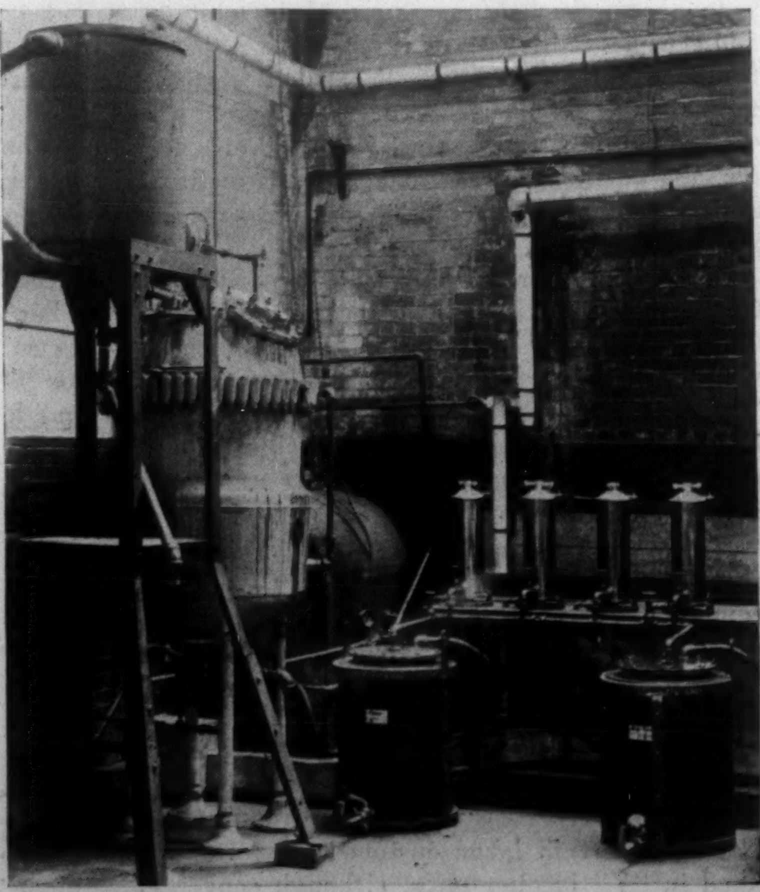
The "Y" lacquer formulas of today did not easily "arrive" in their present state. The writer's development of them has extended over several years. In this work he was especially fortunate in his contacts with his immediate superior, Mr. William B. Price, Chief Chemist and Metallurgist, who brought the early results of the investigation to the attention of the Vice President and General Superintendent, who is a firm believer in well directed research. The latter has always had a keen understanding of the difficulties that confront a worker in unexplored fields. In the early period of "Y" lacquer development he fully appreciated the dual nature of this lacquer in that it was miscible with water soluble compounds as well as with the alcohol soluble type. Because of his grasp of the nature of "Y" lacquer and the mechanism of its formation and use, he frequently made suggestions calculated to stimulate and enlarge the scope of the experimental work. Indeed, no small part of the knowledge achieved as to the variations in characteristics and the varied adaptations is due to his insight into the problems presented, and to the financial support of the work that was authorized by him, which made available the equipment and the man-hours required.

For some time it had been known that formaldehyde and urea would react to form water-white condensation products. The initial ingredients were water soluble, as was also the product even after prolonged "cooking." After drying and hardening to the final state, a most serious defect was that the product was rather easily disintegrated by water. This problem of water solubility was solved by the use of salicylic acid. The complex urea-formaldehyde-salicylic acid compounds become insoluble on baking at approximately 275°F. and form a very hard film which is extremely resistant to perspiration and sulphur gases.

While the development of the nitrocellulose lacquer type of enamels depended on the production of a nitrocellulose of lower viscosity than normal, one of the problems with "Y" lacquers was to gain sufficient viscosity to facilitate spraying. One method of accomplishing this is by the addition of nitrocellulose to the synthetic "Y" lacquer mixture. But, first, it was necessary to get the formaldehyde-urea-salicylic acid complex in a miscible state. A balance of a plurality of solvents such as denatured alcohol, butyl alcohol and ethyl lactate, allowed the addition of the desired percentage of nitrocellulose.

On one occasion, when an especially flexible film was required and some difficulty was encountered in adding sufficient plasticizer without losing the clearness of the film and obtaining "milkiness," the General Superintendent was told of the negative results but that it was still believed that the problem could be solved. His reply has ever since been in the writer's mind, as a continuing inspiration in all difficult problems. His words were, "Well, don't let anyone take that enthusiasm from you." It is needless to say that such staunch support in the face of negative research results, was a powerful stimulus to continue on to positive results. It is now feasible to add plasticizers in practically any desired proportion, and possible to produce very flexible, clear, transparent lacquers which may lead to a very large use in certain fields.

Although the addition of a high percentage of plasticizer was primarily for the development of a clear, transparent, flexible film, its larger use up to this time has been in pigmented enamels. The addition of pig-



Part of Plant for Making "Y" Lacquer

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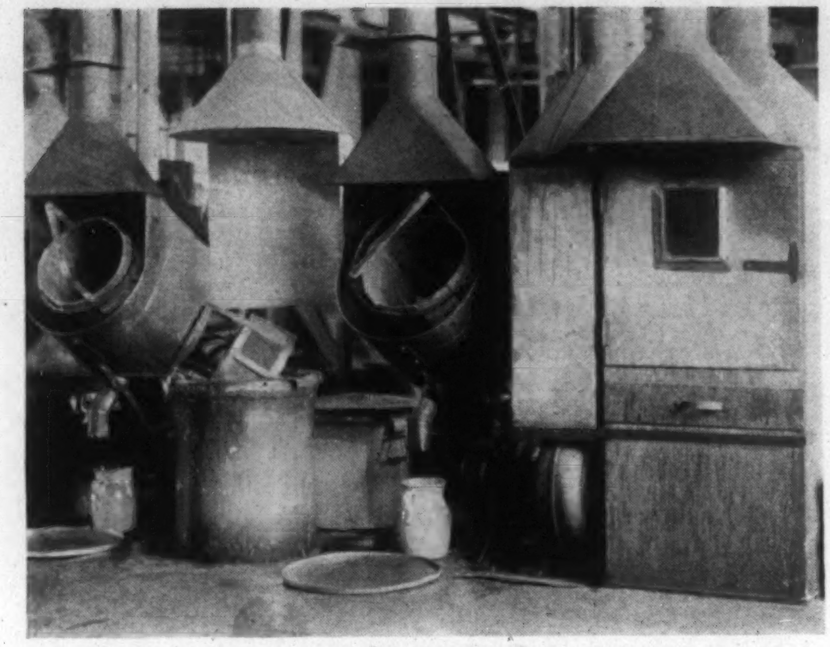
*Research Chemist, Scovill Manufacturing Company, Waterbury, Connecticut.



A Bulk Dipping Unit

ments to a lacquer tends to make for brittleness which tendency is readily overcome by using a base lacquer that permits the high additions of plasticizers.

After an extended use of a spray "Y" lacquer formula containing a minor percentage of nitrocellulose, comments began to come in from the manufacturing department to the effect that a yellowish color was sometimes observed when the lacquer was applied to a silver plated article. This so-called yellowish color was very slight and variable and was due to a combination of cleaning procedure and probably to an overbaking of the lacquer. The temperature of 275°F. usually employed for baking is near the critical temperature for the decomposition of nitrocellulose. With the knowledge that the acetate of cellulose was more stable at the baking temperature than the nitrate of cellulose, the research was directed to the incorporation of the acetate of cellulose in new formulas. At a time when tests had just been completed indicating that a few of the new "Y" lacquer (acetate) formulas could be sprayed on silver, baked with considerable latitude as to overbaking, retain their whiteness, and in addition have the longest resistance yet to moist sulphur fumes as determined by accelerated testing, the manufacturing department asked if a lacquer could be recommended for a large order of cocktail shakers to be finished in silver on the outside. Fortunately, the newly developed "Y" lacquer had the necessary resistance to alcohol.

All the lacquer made by the Scovill Manufacturing Company is used in its own finishing department. There is no intention of selling lacquers to the outside user so, without profits of outside sales, a natural question is "Did the research pay?" It is definitely known that it has paid. Considerable value in labor and materials is put in a finished high quality vanity case, cigarette case, lipstick, perfume bottle holder, and similar metal articles, and the lacquer that best protects the surface is the cheapest. Furthermore, when one gallon of lacquer will completely coat two thousand single compact vanity cases, a cost of $2.00 or $5.00 per gallon is unimportant compared with the quality characteristics of the protective film. The profit to the Scovill Manufacturing Company has consisted of the accrued good will of its customers as reflected in no complaints from some customers where formerly they were quite frequent, and the demand by certain large customers for vanity boxes finished in "Y" lacquer only, although conventional nitrocellulose lacquer would cost less. Even during the depression there has been a steady increase in our use of "Y" lacquers although they are somewhat more expensive.

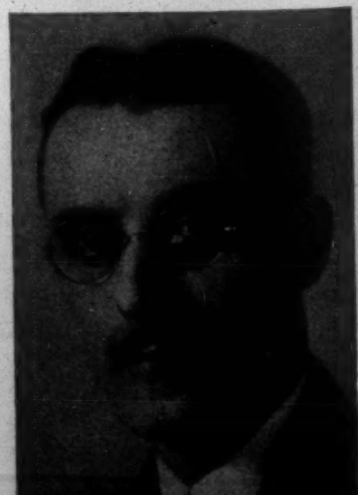
The laboratory has worked very closely with the manufacturing department in this development. These factory contacts brought pleasant relationships with men possessing a spirit of adventure which keeps them tolerant, broadminded and enthusiastic, qualities often ascribed to research men, but in this case at least, equally shared by production men eager for new and improved products.

The environment of this experimental work in the chemistry and test department, instead of in the manufacturing finishing department, was favorable to the research. Under such conditions the workers do not become too much enmeshed in the problems of production. However, the coöperation was sufficiently close to enable the research staff not only to help in current difficulties where lacquer was used but also to foresee problems that should be solved in anticipation of the future needs of the production department. The continuation of this detached and yet coöperative position is due to the foresight of both the general superintendent and the chief chemist. Under such an environment and with such coöperation from the manufacturing department heads, it is possible to tackle new problems with a feeling of security and with a great deal of zest for the romance of the research game. Many who have a position in research such as the writer holds are not so fortunately situated. In this series of Case Histories in Research, the opinion has been emphasized that upon the attitude of the management toward the problems and those who work on them largely depends success or failure of the research. In this opinion the writer fully concurs.

Timken Steel Announcement

At a special meeting of the Board of Directors of The Timken Roller Bearing Company held June 16th, **H. H. Timken** resigned as President of the Company, and **Wm. E. Umstattd** was elected President. Mr. Timken remains as Chairman of the Board. **Henry H. Timken, Jr.,** was elected a Vice President of The Timken Roller Bearing Company and a Vice President of The Timken Steel & Tube Company.

Hamaker, Vice-President of Berger Manufacturing Co.



L. S. Hamaker, Sales Promotion Manager of Republic Steel Corporation, Youngstown, Ohio, has been advanced to the position of Vice-President and General Manager of The Berger Manufacturing Company, Canton, Ohio, wholly owned subsidiary of Republic, it is announced by B. F. Fairless, First Vice-President of Republic. The appointment was effective June 1. Mr. Hamaker began his career in the steel industry in the sales department of The Berger Manufacturing Co. and later was made Advertising Manager. During a series of mergers he became Advertising Manager of United Alloy Steel Co., Central Alloy Steel Corp., and finally of Republic Steel Corp., when that organization was formed. He was appointed Sales Promotion Manager of Republic in 1931.

Crystal Structure as a Guide in
The Working of Magnesium Alloys

By W. Schmidt*—translated by G. E. Doan,** and condensed

THIS example shows what crystallographic research has contributed to the improvement of operating practice in the case of Elektron metal (an alloy of 87 to 95% magnesium, 4 to 10% copper, 1 to 3% zinc). Published reports[1] give the details of the work which is here reviewed as a whole. The applicability of these improvements in operating practice to other metals can not be universally assumed.

> **NO ONE questions the fact that the study of crystal structure by X-rays is the outstanding development of the last 20 years in theoretical metallurgy. But engineers repeatedly ask the question: "What have X-rays done for practical metallurgy?" The following correlated abstract by W. Schmidt in the October, 1933, *Zeitschrift für Metallkunde*, summarizes the practical contributions of crystal structure studies to the manufacture and use of magnesium alloys. It illustrates the accomplishments of an entire school of investigators (and the leading school at that), in this new field.**
>
> **—Gilbert E. Doan**

MECHANISM OF DEFORMATION

Before dealing with poly-crystalline material, first consider the mechanism of deformation of a single crystal. This mechanism in magnesium is illustrated in Figs. 1 and 2. At temperatures below 225°C. elongation takes place by the gliding of crystal fragments parallel to the basal plane of the hexagon.

The dependence of the *yield point* upon the orientation of the crystal with respect to the stress may be seen in Figs. 3 and 4. For *incipient* slip (elastic limit) a shearing stress of 82.9 g./mm.^{2} parallel to the basal plane is necessary. If the direction of the applied tensile stress is at 45° to the basal plane of the crystal the minimum value of yield point is obtained; if the direction of stress is either parallel to the hexagonal axis of the crystal or at right angles to it, elongation of the crystal is theoretically impossible.

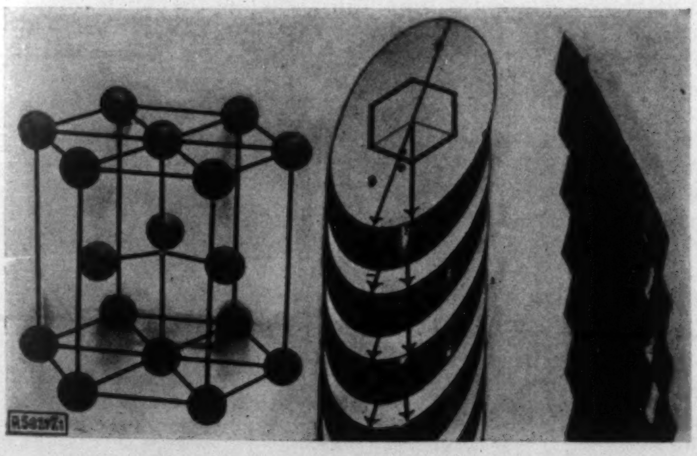


Fig. 1. Slip mechanism of the magnesium single crystal

TEMPERATURE OF DEFORMATION

In tensile tests at temperatures above 225°C. the pyramid planes of the first order in the first setting $\{10\bar{1}1\}$ occur as supplementary planes of slip. This results in the creation of 12 new potential slip planes.

Fig. 5 on previously extruded rod shows that a sudden improvement of forgeability is obtained at temperatures of 210°C. and above.

Fig. 6 shows a magnesium crystal elongated at 225°C. which at first showed basal slip only. In the further progress of the tensile test, however, another set of slip planes, namely those parallel to the pyramidal surfaces, develops. They are indicated by the characteristic radial lines.

The elongation of a single magnesium crystal at temperatures below 225°C. depends largely upon the direction of the deforming force because slip is limited to a single system of slip planes. A crystal may behave as very brittle in one direction and very ductile in another. At temperatures above 225°C. a far greater multiplicity of slip processes is possible. Therefore, for industrial shaping (forging, rolling, pressing, etc.) only those temperatures above 225°C. are to be used. Crystallographic research thus gives an explanation of the sudden change in the formability of the metal at a certain temperature.

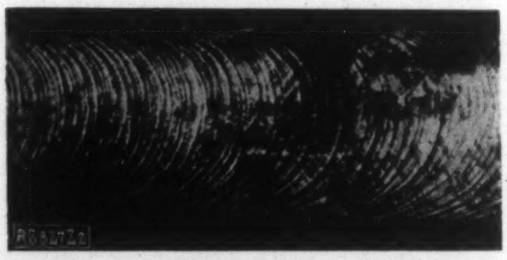


Fig. 2. Elongated magnesium crystal with basal slip lines.

Slip parallel to the basal plane also takes place to a considerable extent at temperatures above 225°C. It seems as though extensive slip parallel to pyramidal planes sets in only after a high intensity of stress has been produced in the crystal as a result of the exhaustion of slip in the basal planes. Since the basal planes orient themselves parallel to the direction of flow of the metal, it is not possible to prevent the extensive development of a fiber structure, even in the case of hot deformed objects.

Velocity of Deformation

In choosing the most advantageous velocity for industrial deformation the behavior of the single crystal again acts as a trustworthy pilot. Fig. 7 shows stress-strain diagrams for single magnesium crystals stressed at 250°C. at various velocities of deformation. The curve marked "S" shows the stress-strain line with a velocity of deformation which is 100 times greater than in the case of the curve marked "L". The areas under the 2 curves, which indicate the total work of fracture, are equal. This condition holds for other temperatures also. Thus the

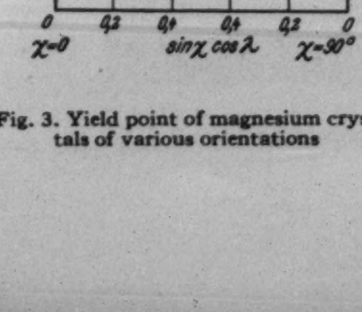


Fig. 3. Yield point of magnesium crystals of various orientations

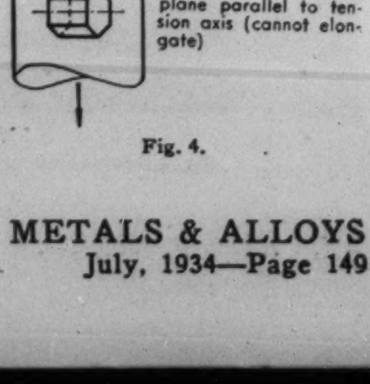

Specimen with basal plane at right angles to tension axis (cannot elongate)
Specimen with basal plane at 45° to tension axis (elongates readily)
Specimen with basal plane parallel to tension axis (cannot elongate)

Fig. 4.

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*Original "Kristallstruktur und praktische Werkstoffgestaltung am Beispiel des Elektronmetalls." *Zeitschrift für Metallkunde*, Vol. 25, Oct. 1933, pages 229-236.

**Associate Professor of Metallurgical Engineering, Lehigh University.

(1) E. Schiebold & G. Siebel. *Zeitschrift für Physik*, Vol. 69, 1931, page 458.

W. Schmidt. *Zeitschrift für Metallkunde*, Vol. 23, 1931, page 54.

E. Schmid. *Zeitschrift für Elektrochemie*, Vol. 37, 1931, page 447.

W. Schmidt. *Zeitschrift für Elektrochemie*, Vol. 37, 1931, page 508.

H. Seliger. *Metallwirtschaft*, Vol. 11, 1932, page 409, 421.

E. Schmid & G. Siebel. *Metallwirtschaft*, Vol. 11, 1932, page 577.

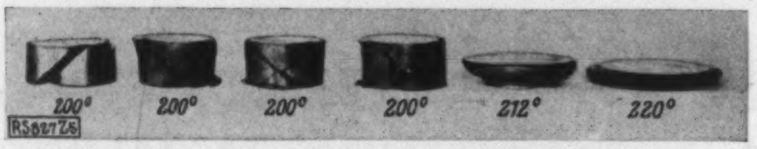

Fig. 5. Sudden change of forgeability of Elektron alloy AZM at 210° C.

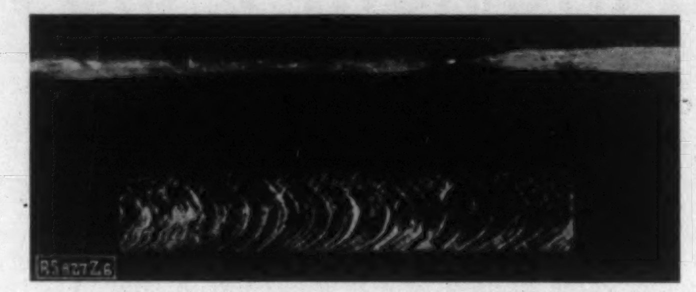

Fig. 6. Magnesium crystal elongated above 225° C.

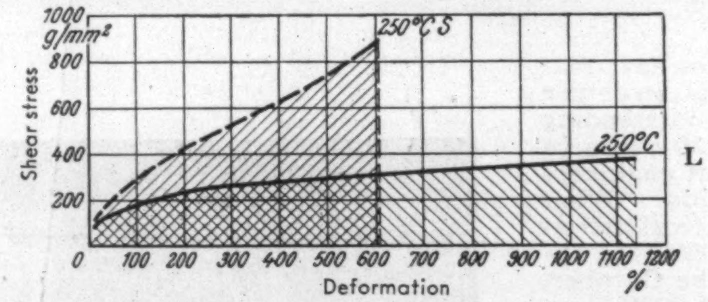

Fig. 7. Stress-strain diagram of magnesium crystals at 250° C.

amount of work which can be absorbed by magnesium crystals at any given temperature is a constant quantity. If this quantity of work is to be used to the greatest possible advantage in producing deformation of the metal, then a very low velocity of deformation should be chosen. In this way high deforming loads are also avoided. As a result the rolling of Elektron is done at a velocity of 8-10 meters per minute (with the softer alloys or with pure magnesium the velocity may be higher). For forging operations hydraulic presses would suggest themselves instead of the impact type of forging. When using high speed rolls or hammering, the changes of shape desired will have to be achieved cautiously in order to avoid fracture.

Twinning

A type of deformation differing from slip or translation, namely, twinning plays a noteworthy role, Fig. 8. The twinning plane is the pyramid plane of the first order and second setting: {10$\bar{1}$2} Fig. 9 shows the twinning process schematically, with the twinning plane ABCDEF.*

It is known that twinning in magnesium single crystals may be produced by *compression* forces parallel to the basal plane, while in a direction at right angles to the basal plane (parallel to the hexagonal axis), twinning requires *tension* forces. This affects the relative values of the yield point in tension and in compression. Both types of deformation, translation and twinning, therefore, differ in extent according to the direction in which the force acts upon the crystal. One and the same crystal when stressed in one direction may be extraordinarily ductile while in the other direction it may be extremely brittle. The same crystal may yield in one direction under a compression stress by the formation of twins while under a tensile stress in the same direction no twins will be formed and the crystal will be less plastic.

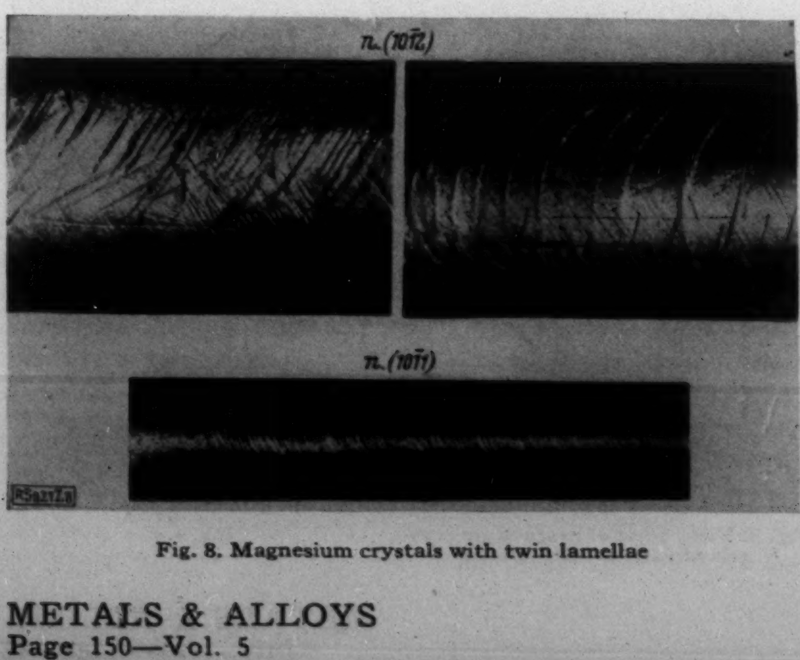

Fig. 8. Magnesium crystals with twin lamellae

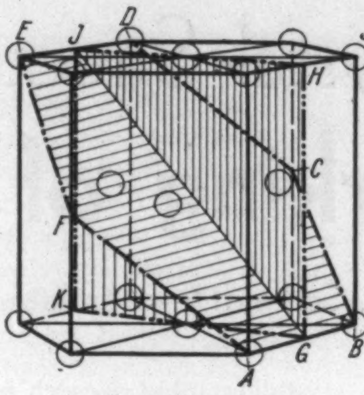

Fig. 9a. Elementary prism of magnesium

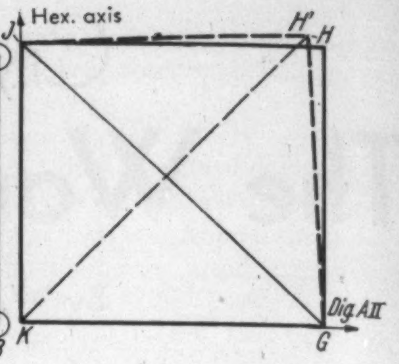

Fig. 9b. Mechanical twin formation in magnesium

Formation of Oriented Structures

Since the process of deformation results in the orientation of crystal fragments with their basal planes parallel to the direction of flow, the original random orientation of crystals in a casting is gradually replaced during working by an oriented or fibered structure which has the deformation characteristic of a single crystal, and exhibits anisotropy under the applied stress as a single crystal would do.

Random Orientation of Crystals

In contrast to this condition *castings* of Elektron show no difference in the tension and compression yield point, since the orientation of the crystals is random. In any chosen direction through the casting just as many crystals will twin under pressure as under tension, provided that the grain size is fine. The generally valid rule that cast objects should be produced with the finest grain size possible thus possesses special significance with Elektron castings. The foundryman therefore makes extensive use of the fact that these alloys can be given a fine grained structure by overheating the melt before casting.

Grain Size and Twinning

Grain size is an especially significant factor in promoting or hindering twinning in Elektron in the case of plastically formed objects of oriented structure.

Table 1. Temperatures and Velocity of Extrusion as They Affect the Tension and Compression Yield Points of AZM Rods

Extrusion Temperature °C	Tension and Compression Yield Points kg./mm.²	Extrusion Velocity mm./sec. 2	6-8	16
250	$\sigma_{0.2}$	24.5	24.0	24.0
	$\sigma_{-0.2}$	22.0	18.0	17.0
350	$\sigma_{0.2}$	23.0	23.0	not determined
	$\sigma_{-0.2}$	13.0	12.5	
350 quenched	$\sigma_{0.2}$	...	24.5	...
	$\sigma_{-0.2}$	...	23.5	...

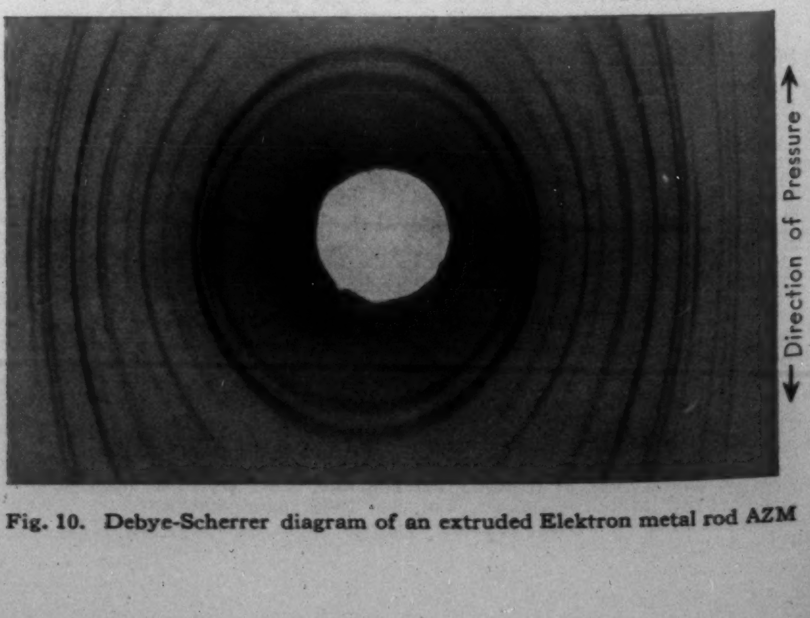

Fig. 10. Debye-Scherrer diagram of an extruded Elektron metal rod AZM

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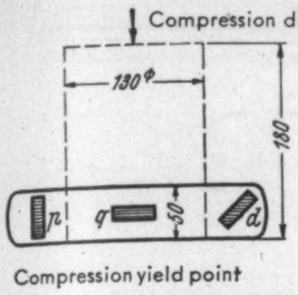
*Translator's Note: The {10$\bar{1}$1} plane may also act as twinning planes, as indicated in Fig. 8.



In objects of this kind the different degree of twin formation under tension and under compression stresses creates a difficult situation. The orientation of an extruded rod may be shown by the Debye-Scherrer diagram of Fig. 10. (Basal plane in the extrusion direction of the rod). Whereas the tension yield point of a longitudinal specimen of this sort is about 20 kg./mm.², the compression yield point is about 14 kg./mm.², the compression stress causing twinning. So low a yield point in compression is a severe detriment for some uses. Twin formation may be hindered by producing the finest grain size possible.

Temperature of the ingot when forged °C.	kg./mm.²	kg./mm.²	kg./mm.²	Difference between values in direction P and D kg./mm.²	%
225	15.9	13.9	11.1	4.8	30
270	19.3	12.3	8.6	9.7	50
320	19.0	8.4	5.7	13.3	70
380	18.6	10.0	5.6	13.0	70
410	23.8	10.6	7.5	16.3	69

Fig. 11. Forging of ingots of Elektron metal AZM in 5 operations at constant temperature

Grain Size in Extrusion

Production of the necessary very fine grain size is possible by inhibiting the spontaneous recrystallization which ordinarily sets in immediately after deformation is completed in the still warm material. Two methods may be used. (1) the rate of deformation may be held very low, then a normal cooling suffices to prevent all subsequent recrystallization. (2) material deformed at normal velocity may be quenched immediately after the deformation is finished. The normal velocity of extrusion of Elektron is 3 to 5 meters per minute. Table 1 shows the difference in the compression yield point and tension yield point of rods extruded at these rates. If such materials are quenched in water immediately on emerging from the press so that spontaneous recrystallization is inhibited, much higher values, also given in Table 1, can be obtained. Similar results may be had if the extrusion velocity is decreased to 0.6 meters per minute or less, when quenching is not necessary. The choice of procedure depends upon the particular shape being extruded.

Fig. 13. Forging of AZM ingot with alternating direction of forming

Tensile and Compression Yield Point in kg./mm.²	p (see Fig. 11 for direction)	q	d
$\sigma_{0.2}$	19.6	18.7	18.2
$\sigma_{-0.2}$	19.1	19.5	18.2

Application of the Slow Extrusion Method

The slow extrusion method is to be preferred in all cases in which large deformations of the profile must be undertaken subsequently, provided these deformations require reheating to the usual 225°C. Material which has been deformed slowly has not yet recrystallized when subsequent hot deformation is undertaken and therefore retains the strength which it has acquired, provided the temperature used remains below the original extrusion temperature. Only upon annealing at higher temperatures is recrystallization and the accompanying decrease of compression yield point encountered.

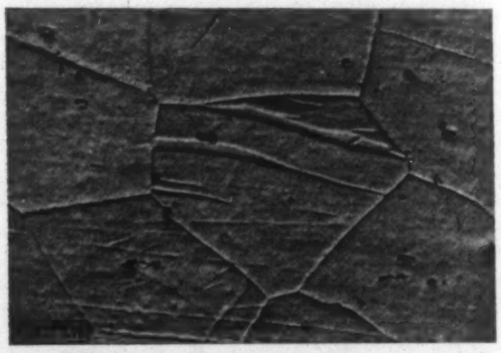


Fig. 14. Pressure twin formation in pure magnesium with preferred orientation.

Production of Forgings

Rules similar to those for extrusion apply to forging. It will rarely be found possible to produce large objects by forging at one temperature. Frequent intermediate anneals are usually necessary. Fig. 11 shows compression tests on cast ingots, the temperature being held constant both during the compression process and during the 5 intermediate anneals. The ingots forged at 225°C. yielded not a single perfect forging, because the edges of the specimen cooled below the temperature necessary for hot form-

IT MAY be crediting a bit more to X-ray methods than they deserve to ascribe present knowledge of how to handle magnesium alloys solely, or overwhelmingly just to those methods.

Schmidt's own terminology seems more accurate, for he refers to the better understanding of the principles underlying the behavior of magnesium that has arisen from the application of crystallography. It did not take the X-ray evidence to tell that magnesium is hexagonal, and the difference in ductility along different axes was connected with the structure before X-ray evidence was available. Twinning is shown by the microscope and its role is important.

X-ray attack is a convenient tool and the facts thus brought out aid greatly in giving a deeper insight into the crystallography of alloys. But unless the X-ray method is aided by the older and less spectacular methods of crystallography of alloys, by microscopic studies and by prosaic mechanical tests, the knowledge would be as incomplete as it would be were X-ray methods neglected.

Schmidt's discussion seems to us to be a fine argument for bringing to bear *all* methods of attack rather than for the glorification of a single method.—H. W. Gillett

Fig. 12. Forging of ingots as in Fig. 11. Elektron metal AZM with decreasing or increasing temperature sequence

Forging in steps	Case I Decreasing Temperature °C.	Case II Increasing Temperature °C.
1. Step from 180 mm. to 120 mm. at	400	300
2. Step from 120 mm. to 90 mm. at	380	330
3. Step from 90 mm. to 70 mm. at	360	360
4. Step from 70 mm. to 55 mm. at	330	380
5. Step from 55 mm. to 50 mm. at	300	400

Tensile and Compression Yield Point in kg./mm.² (Average value)

Direction	Case I Yield Point Tension	Case I Yield Point Compression	Case II Yield Point Tension	Case II Yield Point Compression
p	18.0	12.0	10.0	8.0
q	12.0	18.0	8.0	10.0
d	8.0	8.0	5.0	5.0

Table 2. Reductions for Extruded and Rolled Rails

Experiment	Extruded Rails Reduction %	Rolled Rails Reduction %
1	80.0	74.0
2	44.5	38.7
3	66.8	60.2

Table 3. Influence of the Straightening Process on the Mechanical Properties of Elektron Sheets

Specimen Location	Tensile Strength Kz kg./mm.²	Elongation %	Elastic Limit $\sigma_{0.02}$ kg./mm.²	Yield Point $\sigma_{0.2}$ kg./mm.²	Condition
at right angles	25.5	6.1	10.2	18.1	Original
parallel to rolling	22.3	1.3	9.1	17.1	Material
at right angles	25.8	11.1	8.3	16.0	100 times through the
parallel to rolling	20.0	5.0	4.8	6.8	straightening rolls

Table 4. Elastic Properties of Straightened Elektron Rods o. AZM Alloy 20 mm. diameter (in tension)

Additional tension of the straightening rolls in mm.	$\sigma_{0.02}$ kg./mm.²	$\sigma_{0.1}$ kg./mm.²	$\sigma_{0.2}$ kg./mm.²	Increase in thickness of the rod
Original material	21.0	22.6	23.2	..
0.65	19.8	22.4	23.2	1
0.975	7.2	11.6	21.8	2
1.30	9.1	10.0	10.6	3.5

0,5%
0,7%
0,9%
1,1%
1,5%

Fig. 15. Grain size of pure magnesium as related to amount of working

ing, and cracks occurred. The variation in tension and compression yield points in specimens taken from the forging at various angles was due, of course, to the preferred orientation of the basal plane caused by twinning. This difference was the more pronounced the higher the forging temperature. The crystallographic explanation of this is that at the higher temperatures complete recrystallization takes place between each forging operation, and after the final operation. Such large regions of similarly oriented grains are thereby produced that the polycrystalline mass begins to resemble a single crystal in the anisotropy of its resistance to deformation in various directions. To prevent recrystallization in forged objects, each intermediate anneal and each subsequent forging operation should be carried out at a temperature somewhat lower than the preceding one. To test the validity of this view point some parallel experiments, shown in Fig. 12, were made with a contrary procedure and poorer results.

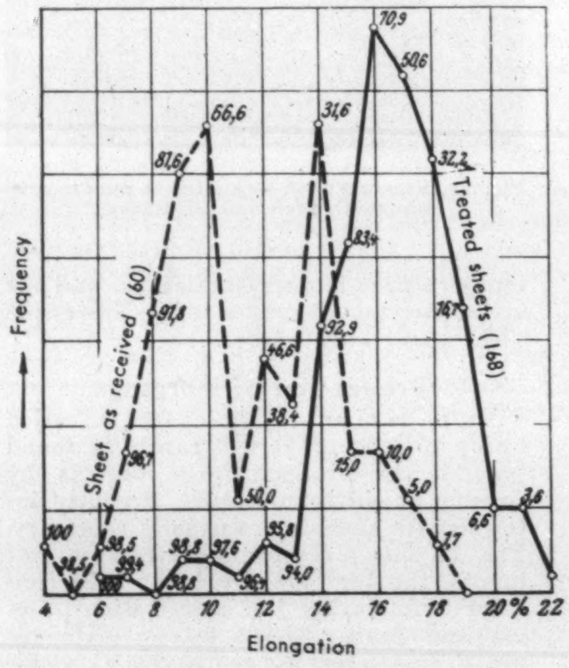
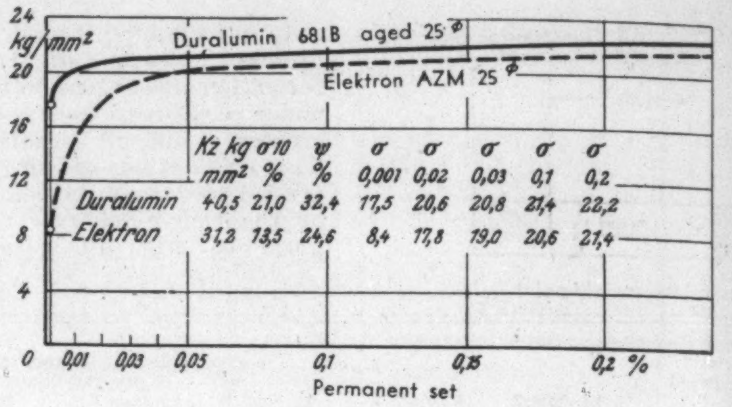


Fig. 16. Improvement in elongation of Elektron sheets by means of cold rolling and rapid anneal

In many instances it may be useful to produce a comparatively high yield point in one direction, e.g. in propellors or compressor shafts whose stresses are predominantly in one direction only.

When equal resistance to deformation is desired in all directions, this fiber structure is most difficult to avoid, for example in production of the forged crankcase housing for the radial motor of an airplane.

If an ingot is compressed in one direction only, as shown in Fig. 11, and specimens are taken out parallel, perpendicular and at 45° to the direction of compression, the resulting tension and compression yield points, as illustrated in Fig. 12, show extraordinarily varient values. The 45° specimens show equal, but very low values. Forgings with uniform strength values may be produced by carrying out the deformation so that a direct approach to the final shape of the forging is abandoned by periodically interjecting other shaping steps which partially *undo* the approach to the final form sought. Thus an ingot is given a reduction of some 30%, then reversed and stretched 10%. Specimens from an ingot so forged taken out in the same directions as those shown in Fig. 11 yield the strength values of superior uniformity given in Fig. 13. At the beginning of forging the random orientation of grains in the ingot permits of easy deformation. As deformation progresses, more and more crystal grains rotate into the direction of flow of the metal so that an increasing proportion of the grains becomes oriented with their basal planes perpendicular to the direction of the forging stress. Since a pronounced orientation perpendicular to the direction of stress requires, theoretically at least, an infinite force to produce deformation, unless fracture occurs, therefore each step in the straight-forward operation produces a decrease in the possibilities of further deformation. Actually the indirect method is the more economical one. Intermediate annealing is less practical than alternate compression and tension.



	Kz kg mm²	σ10 %	ψ %	σ 0,001	σ 0,02	σ 0,03	σ 0,1	σ 0,2
Duralumin	40,5	21,0	32,4	17,5	20,6	20,8	21,4	22,2
Elektron	31,2	13,5	24,6	8,4	17,8	19,0	20,6	21,4

Fig. 17. Stress-strain diagrams for duralumin and Elektron AZM

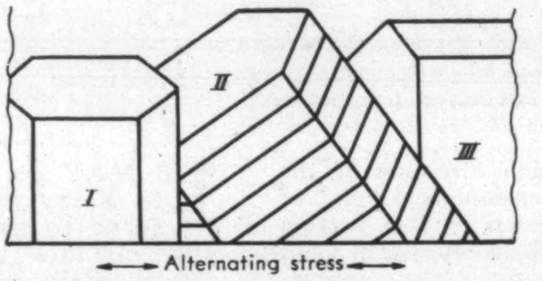


Fig. 18. Alternating stress with varying crystal orientation.

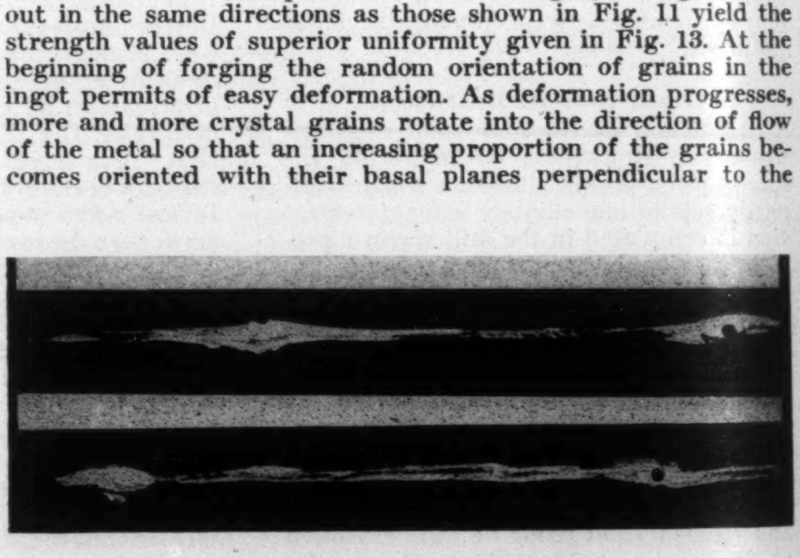


Fig. 19. Strengthening by drilled holes

The Rolling Process

The fiber structure set up by deformation causes the greatest trouble in the case of rolling, where it is impossible to reverse the direction of deformation. So a pronounced fiber structure is rapidly developed with the basal planes parallel to the surface of the sheet. In the intermediate anneals this fiber structure is somewhat broken up, but not to such an extent that

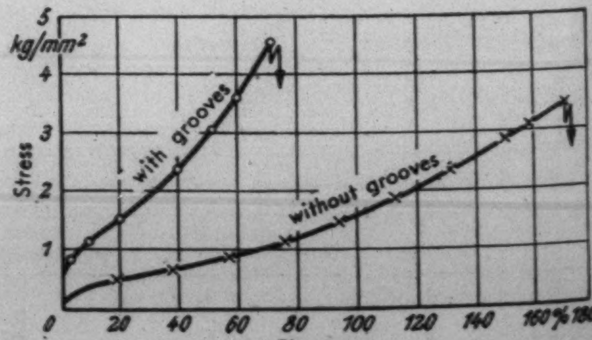


Fig. 20. Strengthening a magnesium crystal by longitudinal grooves

those large reductions customary with other metals may be carried out. Rolling Elektron sheet requires many passes of comparatively small draft with successive annealings. In the best practice, flat bars are first extruded and then rolled to sheet, thus, in so far as the sheet sizes will permit, one comes down to a thin sheet in a single pass. An extruded bar also presents a more favorable grain orientation than does a cast ingot which has been pre-rolled to the size of the extruded bar. The orientation of the basal plane is such that more favorable slip conditions are present. Table 2 shows for pure magnesium, a comparison of the drafts attainable with extruded bars and pre-rolled material. This case deals with pure magnesium which is relatively highly formable.

The Final Annealing of Sheet

In final annealing of a material so extensively fibered, there is danger that a critical deformation may lead to pronounced coarse grained structure. Only a very few grains may be left with their bases at an angle of 45° with the length of the sheet and a large majority oriented with their basal planes parallel to the surface. Then any deformation will produce a varying degree of lattice distortion in various parts of the sheet. Only those very few grains so orientated as to be able to deform can slip or twin.

Fig. 14 shows the structure of a material in the above described fibered condition after it has been compressed. One of the grains shows pronounced twinning bands while the other grains are practically unchanged. If such material is annealed it suffers excessive grain growth. Fig. 15 shows experiments carried out to produce single crystals from magnesium sheet by long annealing at high temperatures. The dependence of grain size upon degree of deformation is not new but the degree of sensitivity of a fibered Elektron sheet is noteworthy. This coarse grain size may be combated by carrying out the final anneal in as short a time as possible, as in an oil bath or between electrically heated plates so that the distorted grains recrystallize simultaneously.

Pronounced basal orientation parallel to the surface of the sheet, is favorable to a high yield point but unfavorable to elongation, which is a measure of cold formability. Hence *major* shaping operations of sheet must always be carried out hot. The final anneal should be so done as to prevent or mitigate an extreme predominance of crystal orientation parallel to the surface of the sheet, with accompanying difficult formability. Hence the *final* draft of about 10% is taken *cold* and the sheet then annealed.

A cold final draft involves a stress so high that it approaches that at which the sheet will crack. By this means alone, is it possible to take advantage of the ultimate slip and twinning possibilities of those crystal grains whose bases still make a slight angle to the directions of stress. Fig. 16 shows frequency data in which the elongation of sheets made by other production methods are compared with those from treatments which have been carried out in accordance with the above described crystallographic principle. ("10% cold rolling, annealing in an oil bath at 300°C.")

Occurrence of Twins in Annealed Sheet

Even in a sheet which has received a final anneal of this kind there is a predominant orientation of the basal planes parallel to the surface of the sheet. This fibering may, however, be further relieved by a mechanical operation on the finished sheet. If such a sheet is bent the fibers on the compression side will form twins. By means of repeated bending to and fro as in straightening rolls, extensive twin formation may be produced with an accompanying change in the mechanical properties. If a sheet of a certain hard-rolled Elektron alloy 2 mm. thick and 2 meters long, is passed 100 times through a set of straightening rolls, the sheet becomes 50 or 60 mm. *shorter* than it was before. Instead of a decrease in elongation which one would normally expect this produces an *increase* in elongation which may be to *double* the previous elongation when measured across the sheet and up to *5 times* parallel to the length of the sheet. The low elongation measured in the hard rolled condition is not really an indication of the formability of the crystals of which the sheet is composed, but is only a measure of the formability under the action of a stress which acts parallel to the fibre axis, that is parallel to the basal plane of the hexagonal crystal. By means of the twinning induced by the to and fro bending and in spite of the further hardening which naturally accompanies it, so many new possibilities of slip under the influence of a stress acting parallel to the surface of the sheet are produced that the ultimate result is increased elongation.

Production of Twins in Extruded Rods

The phenomenon described above is not limited to sheets, but may be observed also in extruded rods, provided the fiber is produced by oblique or crossed rolls. A 25 mm. diameter rod after 2 or 3 passes through such a roll may *increase* in diameter several percent, and decrease in length. Table 4 shows torsion tests on 20 mm. diameter extruded rods.

Suggestions for Construction

Crystal structure research also offers suggestions to the engineer and explains for him phenomena which at first appear incomprehensible.[2]

Fig. 17 shows a stress-strain diagram of duralumin compared with that of Elektron alloy. When Elektron metal is substituted for duralumin attention must be paid not only to the stress at which the deformation of .001% is obtained in a tensile specimen but to the entire course of the stress-strain curve.

Elektron shows an extraordinarily high hysteresis under cyclic stresses when compared with aluminum alloys. However, the high damping capacity of Elektron is not to be explained in terms of an insensitivity to localized stress concentration. Offhand it appears incompatible to have simultaneously a high damping capacity and a high degree of sensitivity to notch. Although no absolutely proven crystallographic explanation of this behavior has been advanced, one may set down a working hypothesis that may later lead to a complete explanation. If we attempt to visualize the orientation of Elektron grains at the edge of an object or at the base of a notch, that is at the surface (of the object) at which alternating stresses will act, then we must expect to find some of the crystal orientations corresponding to those shown in Fig. 18, at I and III. Neither of these 2 orientations can deform under the action of stress and both are completely elastic and brittle. Other crystals, such as those shown in II lying at an *angle* to the stress must undertake to behave as a plastic member between 2 brittle neighbors. Under intense stresses the only possibility for the system to yield under these stresses is by slip in crystals with orientation II. The entire plasticity of the crystalline conglomerate depends upon these favorably oriented crystals. In the interior of the object in which the individual crystals are at liberty to react to the stress in accordance with their orientation, these interactions between elastic and plastic regions of various crystal orientations lead to the well known high damping action of Elektron. If it were possible somehow to interfere with slip in the crystals of orientation II which happens to lie at the edges of the object, then at those points where the highest stress concentrations exist, plastic deformation would be obstructed and a resultant rise in stress intensity would obtain. The extent of this rise would exceed that of other materials of equal damping capacity. An investigation was therefore made to ascertain in the case of a crystal so oriented with respect to the deforming stress as to be highly plastic, to what extent the slip system may be impaired by intentional injury. Fig. 19 shows crystals with holes bored into them before tension was applied. If this were done to a metal which possessed more potential slip planes than does magnesium, the fracture would without fail pass through the holes. In our case, however, slip or translation has been so seriously interfered with by the boring of holes that the bar required higher stresses for plastic deformation at the bored places and as a result it fractures at a point between the holes. Fig. 20 shows the effect on longitudinal grooves made parallel to the test length (axis) of a single crystal tension specimen. The slip system was again interfered with by these grooves so that the tension tests required higher stresses and exhibited only about ¼ of the elongation which would have been obtained from a single crystal without the grooves. This experiment shows that any metal which is able to slip in one system only is severely injured in its slip possibilities, even in the case of the most favorable orientation, when it is injured mechanically. In case the crystals marked II in Fig. 18 experience a similar obstruction to their slip possibilities, then they will not be able to deform until a higher stress intensity has been reached and therefore will not be able to provide so promptly for the reduction of a localized over stress at the edge or notch of the part as would appear possible from the damping capacity of the entire volume of the material. Perhaps these relations explain the fact that those structures in which notches and local stress concentrations are avoided can be made of Elektron metal with considerable saving in weight as compared with heavier materials, whereas sad experiences are met if the engineer does not keep these considerations clearly in mind.

The engineer should therefore attempt to distribute the stresses as much as possible in case of dynamic loading by the use of suitable designs. Similar precautions should also be taken in the redesign necessary in substituting Elektron for other materials.

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[2] W. Schmidt. *Zeitschrift für Metallkunde*, Vol. 23, 1931, page 54.

INTERNAL STRESSES

Part Two of a Correlated Abstract in Five Parts by Charles S. Barrett[†]

X-RAY METHODS OF REVEALING INTERNAL STRESSES

The X-ray methods used in internal stress studies will be discussed under the following headings: the Laue method, the peripheral widening of spots, the radial widening of lines, the shifting of lines, and the intensity of reflection. It will be necessary to devote a disproportionate amount of space to the Laue method in this review, not because of any exceptionally great potential value to internal stress research, but because of the amount of attention it has received and the complexity of the factors which enter into the interpretation of Laue photograms of deformed and internally stressed metals. In fact the space that must be given to the X-ray methods as a whole in order to cover them adequately cannot be taken as proportional to their effectiveness in internal stress research as compared with the mechanical methods, although it may indicate in a rough way the amount of attention that has been paid to them.

1. THE LAUE METHOD

Apparatus

Laue photograms are prepared in an apparatus similar to that sketched in Fig. 8. A beam of heterogeneous X-rays (i. e., a beam containing a broad band of wave lengths, such as is emitted from an X-ray tube with a tungsten target) is collimated by a series of pinholes and penetrates a thin crystalline specimen, undergoing diffraction in the specimen. The diffracted beams emerging from the specimen are registered on a photographic film or plate, behind the specimen, upon which they produce a pattern of "Laue spots."[*]

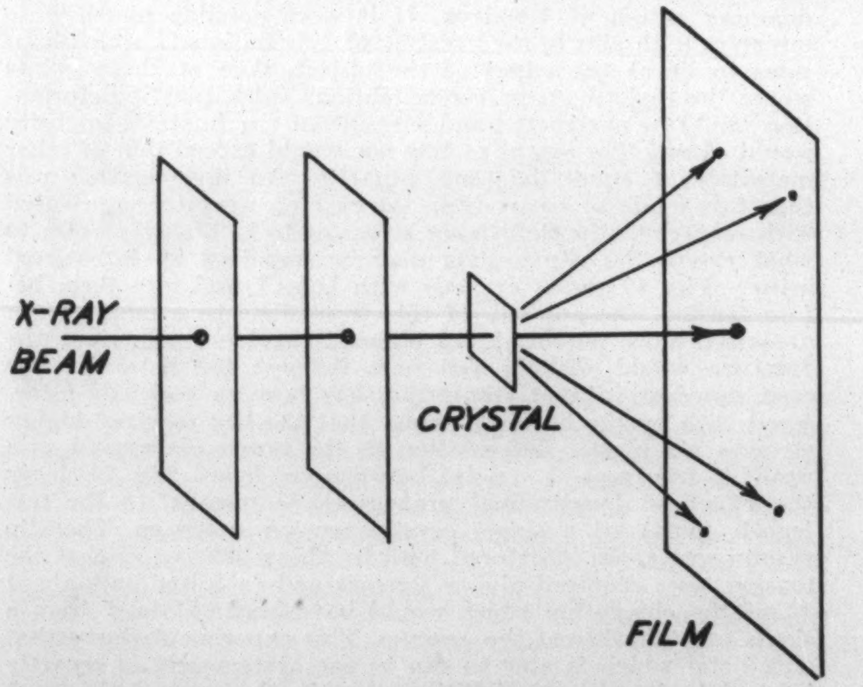

Fig. 8. Diagram of apparatus for preparing Laue photograms.

The distinguishing feature of the Laue method is the presence in the primary beam of components of many wave lengths. A given atomic plane will reflect from this beam a component whose wave length, λ, is determined by the interplanar distance d and angle of diffraction θ in accordance with the Bragg law $n\lambda = 2d \sin \theta$ (n is an integer indicating the "order" of the diffraction). If a crystal is oscillated about an axis so that θ varies continuously throughout a range of angles, the diffracted beams will each sweep out a spectrum on the recording film, that is, they will form streaks which indicate, along their length, the distribution of intensity among the different wave lengths in the primary beam (modified by the variation in photographic efficiency with wave length and by absorption in the specimen). A similar production of spectra will occur if a crystal is bent so as to provide a varying angle of incidence of the X-ray beam on the atomic planes. The spectrum from a tungsten target X-ray tube operating at 40, 50 or 60 kilovolts, as modified by the efficiency of the photographic emulsion, is plotted in Fig. 9. It will be seen that the photographic blackening is intense between the short wave length limit ($\lambda = \frac{12.34}{KV}$ where KV is the kilovoltage applied to the tube) and the K absorption limit of the silver in the emulsion at $\lambda = 0.484$ A. U., while a sudden drop in blackening occurs at the silver K absorption limit and another at the bromine K absorption limit ($\lambda = 0.912$ A. U.).

The Optical Analogy. Asterism

The well known analogy pointed out by W. L. Bragg between diffraction of X-rays by atomic planes and the reflection of light by plane mirrors extends also to the case of diffraction by *bent* planes of atoms and the corresponding optical reflection from *curved* mirrors. It also applies to the case of reflection from crystal fragments arranged on a curved surface, corresponding to reflection from small mirrors arranged on a curved surface.

The analogy is very serviceable in the study of strains by

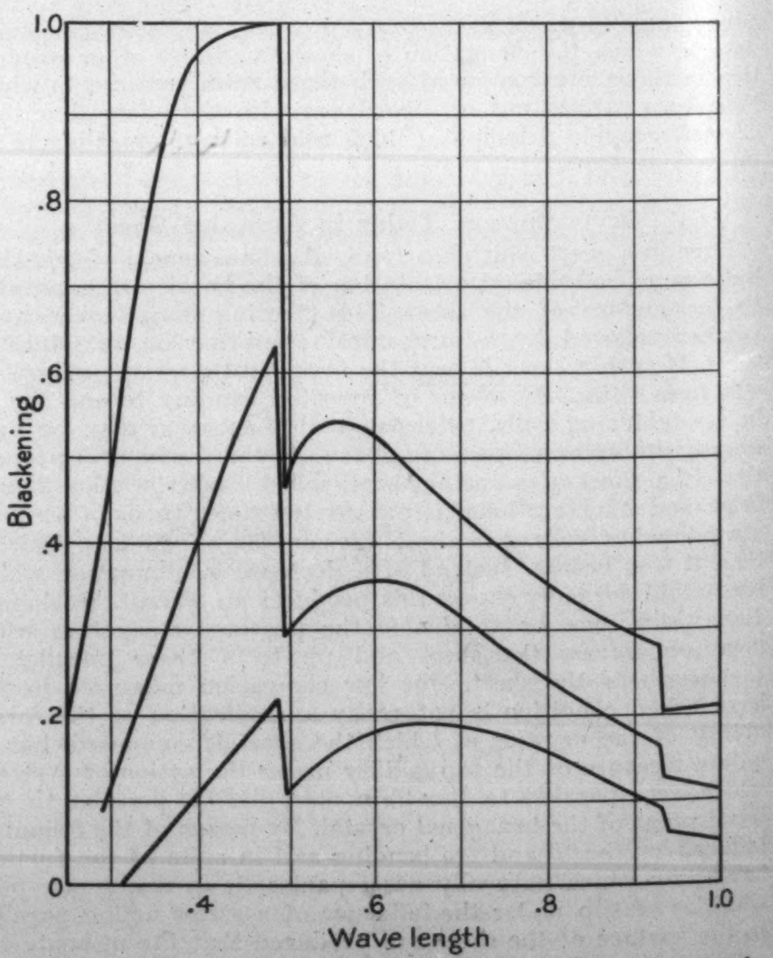

Fig 9. Photographic effect of X-rays from tungsten tube operated at voltages of 40,000, 50,000 and 60,000 volts for the lower, middle and upper curves, respectively. (Wykoff)

the Laue method, for it emphasizes the fact that the Laue method registers strains by virtue of the changes in orientation of reflecting planes. For example, one sees at once that spots from an undistorted crystal should be sharp (their size is determined only by the diameter of the primary beam, its divergence, and the thickness of the crystal penetrated), while these spots should be enlarged or elongated when the crystal is subjected to mechanical strains which cause bending or warping of the reflecting planes. The characteristic appearance of a photogram from a bent crystal is shown in Fig. 10 where the spots from an aluminum crystal are spread radially by plastic deformation of the crystal, constituting the "asterism" first described by F. Rinne.[25]

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[*] Variations of this arrangement have been used in which the photographic film is placed on the opposite side of the crystal from its position in Fig. 8, and in which the plane film is replaced by a conical film or a cylindrical film supported about the beam as an axis. For discussion of the merits of these arrangements in metallurgical studies see F. Regler, *Zeitschrift für Physik,* Vol. 74, 1932, page 547, and *Mitteilungen des Technische Versuchsamtes,* Vol. XX, 1931.

[†] Metals Research Laboratory, Carnegie Institute of Technology.

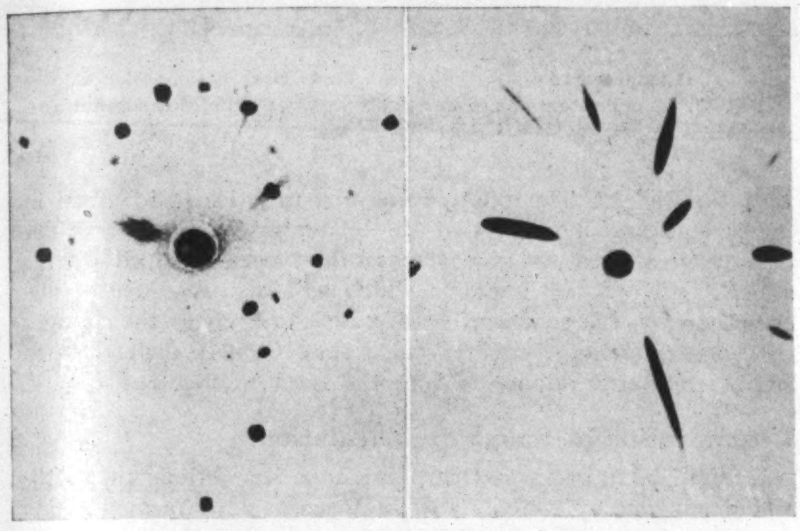

Unstrained Elongated 9 %

Fig. 10. Laue photograms of an aluminum crystal before and after a 9 % elongation. (Czochralski)

From the mirror analogy it may be seen that the way the different spots elongate depends on the orientation of the bending axis with respect to the X-ray beam. It will also be seen from the analogy that the length to which the spots are elongated will depend not only on the radius of curvature of the reflecting planes but also on the area of the crystal struck by the beam, for the elongation is related to the divergence in orientation of the portion of the crystal bathed in the rays.

It is further clear from the optical analogy that a large number of crystallites with slightly diverging orientations will produce an array of spots which may closely resemble asterism from a bent crystal. This type of photogram has been obtained with recrystallized rock salt (Fig. 11)[26] and with a recrystallized sheet of copper[27] both being cases where elastic stresses were definitely absent. If the individual spots are sufficiently small or if their reflections overlap as the result of an insufficiently collimated primary beam, the asterism produced by such a preferred orientation of crystallites will be similar to that produced by a bending of the reflecting planes.[28] Under these circumstances the continuity of the streaks will be apparent, of course, rather than real.

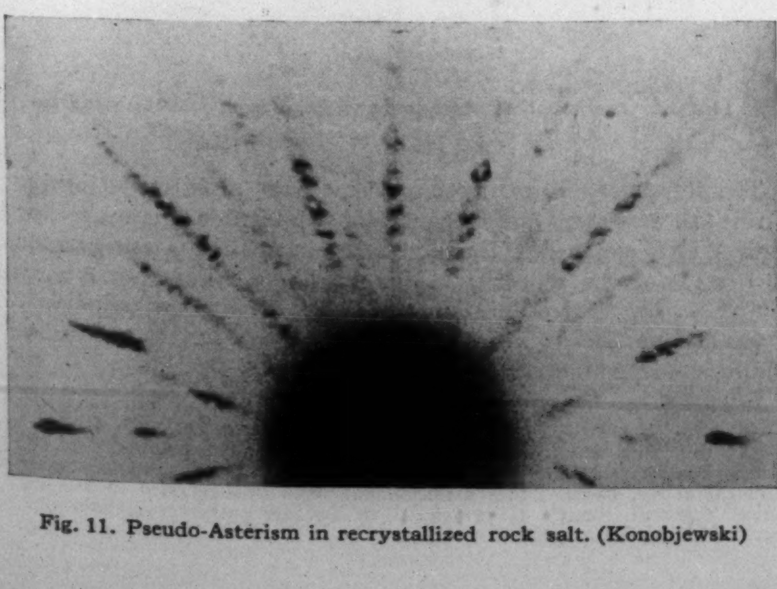


Fig. 11. Pseudo-Asterism in recrystallized rock salt. (Konobjewski)

Elastic Deformation as a Cause of Asterism

Any deformation—elastic or plastic—which produces varying orientations of an atomic plane in a crystal can produce asterism in Laue photograms. To be sure, asterism is observed but rarely in crystals strained within the elastic limit, but this is merely because of the slight curvature produced in most crystals by such stresses. Cox and Blackhurst's[29] failure to observe it with a tungsten single crystal wire stretched elastically is probably to be ascribed to a uniform distribution of stresses which produced inappreciable bending of their specimen. Elastically bent mica shows marked asterism,[26] and traces of it have been detected with elastically stretched polycrystalline silicon steel.[30] The presence of elastically bent regions in plastically deformed rock salt has been also demonstrated by the analysis of the directions of asterism striae.[26, 31] This will be discussed later.

In addition to the asterism caused by elastic bending, a small amount may be caused, as Seljakow has shown,[31] by a reduction in lattice symmetry through non-uniform elastic shear. In the case of rock salt the angle between the cube axes may be altered elastically one degree or so as a result of such shear. No data are available on the magnitude of this effect in metal crystals, but Seljakow suggests that it may be a phenomenon of very general occurrence in metals which have been plastically deformed. We may represent these two causes of asterism in elastically stressed crystals as in Fig. 12: the case of bending is illustrated in Fig. 12a, shear in 12b.

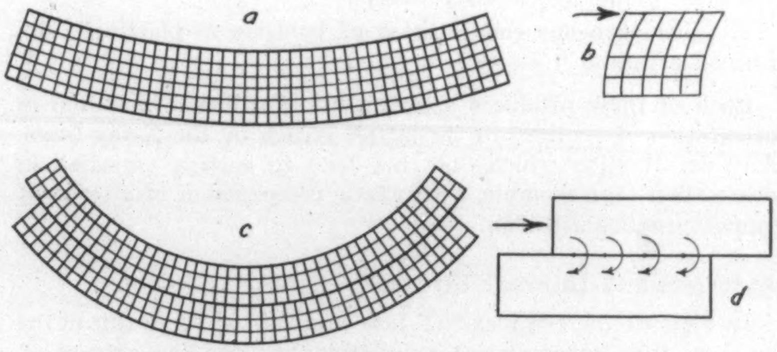


Fig. 12. Diagrams illustrating different causes of asterism.

Plastic Deformation as a Cause of Asterism

It is by a complex mechanism that plastic deformation produces changes in orientation of portions of a crystal, thereby providing the conditions for asterism. Numerous researches by Mügge, Tammann, Gross, Ewing and Rosenhain, Mark, Polanyi, Schmid, Joffe, Taylor, Elam, Gough, and others have shown that plastic deformation of a crystal occurs by layers of the crystal slipping over one another, the gliding motion occurring on definite atomic planes and in definite crystallographic directions.[32]

There are two causes of asterism that have been identified as accompanying this gliding. If the deformation of a crystal is not homogeneous over the whole of the crystal a bending of the gliding lamellae will occur ("bend-gliding," "Biegegleitung");[33] this may be sketched as in Fig. 12c. This takes place, for example, in the extension of a single crystal whose ends are restrained by clamps, or in the case of a grain of a polycrystalline material which is constrained by the neighboring grains.[34] This bending brings about a rotation of lamellae into definite final orientations in the case of single crystals, or into definite deformation structures in the case of polycrystalline metals. Whenever bending-gliding occurs asterism may be obtained; but if a single crystal is deformed so that gliding can occur without external restraint (as for example with an externally homogeneous deformation such as that used by Taylor and Farren[35] and by Burgers and Louwerse[36]) this particular cause of asterism is no longer operative, for bend-gliding does not occur.

Bending that accompanies gliding, discussed above, takes place over the whole of the individual lamellae. There is, in addition to this bending, a local disturbance of the lattice in the neighborhood of the planes on which slip occurs. This has been observed by optical means in deformed rock salt crystals,[37] and by X-ray orientation studies[38] of deformed aluminum crystals. This local curvature (*"örtliche Krümmung"*) consists of a rotation of small regions of the lattice bordering on the glide planes, the rotation being about an axis perpendicular to the gliding direction and parallel to the glide plane as indicated in Fig. 12d. The rotation is similar, both in the position of the axis and in the direction of rotation about the axis, to that which would be experienced by rollers between the lamellae, though the amount of the rotation is less than rollers would undergo and is variable in amount. Yamaguchi showed that most of the fragments are rotated but a few degrees, larger angles of rotation being relatively infrequent; occasional rotations of 20° occur, and in exceptional cases rotations up to 50°. The maximum increases with the amount of relative displacement that has occurred between lamellae.

The rotation of this local type is about an axis determined by the lattice—a crystallographic axis—while the bending of the whole lamella is about an axis lying in the same crystallographic plane but perpendicular to the direction of the maximum resolved force in the glide plane. As the latter axis is determined by the external forces, it is not in general a crystallographic direction. [31, 36]

To summarize, there are a number of causes of asterism:

1. Elastic bending of crystals
2. Inhomogeneous elastic shear of crystals
3. Bending of lamellae accompanying gliding under external restraint (bend-gliding)
4. Rotation of portions of gliding lamellae in the vicinity of the glide planes (local curvature)
5. Inhomogeneous elastic shear of lamellae in plastically deformed crystals.

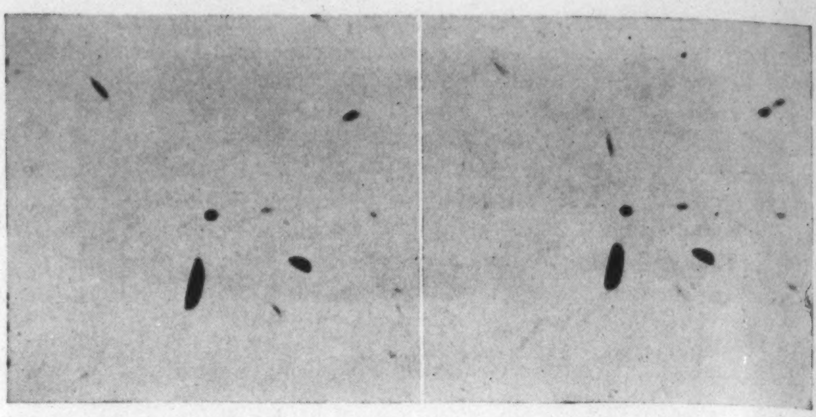
Each of these produces asterism by affording a variation in orientation of portions of the lattice struck by the X-ray beam. Any deformation which does not lead to such a variation in orientation (for example, hydrostatic compression of a crystal) cannot produce asterism.

Asterism and Internal Stresses

In view of the complexities just enumerated there can never be more than an empirical correlation between the amount of permanent deformation and the asterism corresponding to it. In other words, asterism cannot be made an *absolute* measure of permanent deformation, but must be calibrated for each new material and type of deformation.

Elastic stresses are still more difficult to measure by means of asterism. Internal stresses in a cold worked metal produce small distortions which are almost wholly submerged by the more violent distortions accompanying the gliding. Even if the asterism from elastic distortion could be separated from the other, there would be great difficulty in interpreting it in terms of the magnitude of internal stresses, for this requires a knowledge of the radius of curvature of the elastically bent lamellae and the thickness of the lamellae. Konobjewski and Mirer,[26] and Seljakow[31] have worked out the analysis of asterism from elastically bent strips under certain special conditions and the former authors have calculated internal stresses on this basis. But, as Seljakow points out, the analysis can no longer apply when the elastic limit is exceeded. So we come to the conclusion that, since asterism accompanying elastic deformation is very small and asterism accompanying plastic deformation is a complex phenomenon, there is little hope of the *direct determination* of internal stresses with this tool.

Even as a *qualitative* indicator of internal stresses it is unreliable (for the same reasons). We have the experimental observation of Sachs,[39] for example, that an aluminum crystal yielded marked asterism when it was plastically twisted, but after it was straightened produced only slightly widened spots. A similar observation was made by Konobjewski and Mirer[26] on rock salt first bent and then straightened. The latter authors found that normal spots were obtained when the crystal was subsequently straightened if the plastic bending had not been too severe. In both cases internal stresses were presumably present in the single crystals after straightening, yet little or no evidence of it was found. A more striking example is Karnop and Sachs'[40] Laue photograms of a stretched aluminum crystal before and after a stress-relief anneal of ½ hour at 400° C., Fig. 13. The photograms are practically identical in appearance and indicate that the lattice orientations were not detectably altered, yet the stresses had been relieved by the anneal. Other X-ray methods which will be subsequently discussed are, on the contrary, readily able to register the changes that occur during recovery, since they do not depend upon lattice orientation alone, as does the Laue method.†



Elongated 15 % **Same after ½ hr. at 400°C.**

Fig. 13. Laue Photograms of an Aluminum Crystal before and after a stress-relief anneal. (Karnop & Sachs)

Determination of Range of Orientation

It might be in order at this point, to review briefly the methods of analysis by which Laue photograms of deformed single crystals may be solved in terms of orientation changes in the deformed crystals, the methods which have been useful in deciphering the mechanism of plastic flow. The relation between the direction of asterism striae and the axis of bending of a crystal (or the axis of a cylindrical surface on which crystal fragments lie) has been worked out by Uspenski and Konobjewski,[41] by Gross,[42] by Leonhardt,[43] and by Burgers and Louwerse.[36] Leonhardt has published a set of curves showing the way Laue spots elongate with given orientations of the bending axis with respect to the photographic film (curves are given for angles of inclination of the axis to the film of 0°, 30°, 45°, 80°, 90°, the film in each case being assumed normal to the beam.)

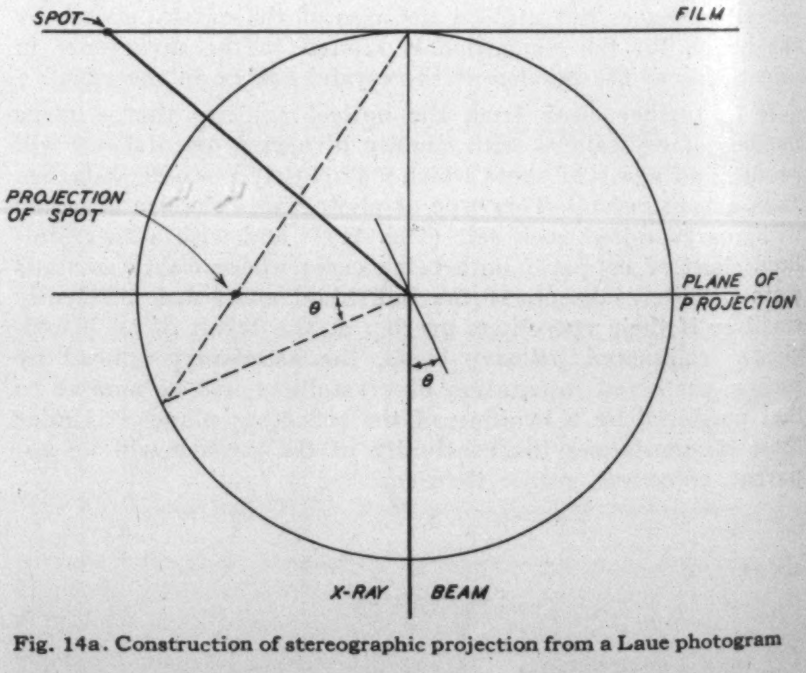


Fig. 14a. Construction of stereographic projection from a Laue photogram

The stereographic projection as a means of interpreting the striae is, however, more generally applicable than are the charts of Leonhardt. The construction of the stereographic projection of the reflecting plane causing a Laue spot is very simple. If the projection plane be taken normal to the incident beam and parallel to the photographic film (Fig. 14a) the rules for its construction are as follows:

1. The X-ray beam, the Laue spot and its projection all lie in

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†As this goes to press G. Sachs' Praktische Metallkunde, Vol. II (Julius Springer, Berlin, 1934) has just appeared. Sachs' remarks agree with the above, namely, that asterism has been unsuccessful in internal stress research though it is useful in revealing the crystallographic mechanism of deformation.

a plane (in the figure this plane is the plane of the page). Therefore the spot itself and the projection of the spot have the same angular position about the beam as an axis.

2. The radial distance of the spot from the center of the projection is equal to $r \tan \frac{90-\theta}{2}$ where r is the radius of the projection sphere and θ is the angle of incidence of the X-ray beam on the reflecting plane; the angle θ may be determined from the radial distance of the Laue spot on the film from the central beam, since this distance is equal to $r \tan 2\theta$.

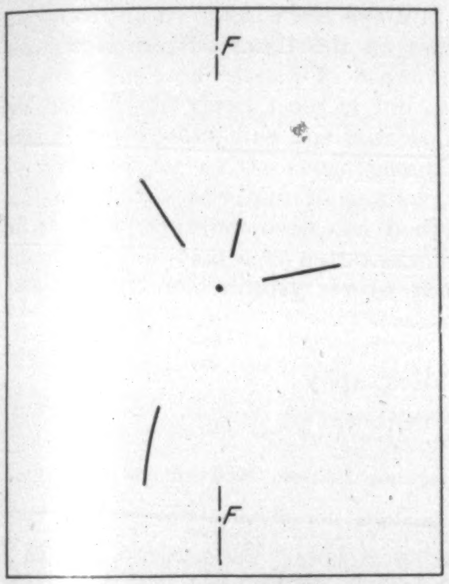

Fig. 14b. Sketch illustrating striae on a Laue photogram. This drawing is to the same scale as Fig. 14a.

If the spots are elongated their projections will be elongated also. The striae in the photogram 14b, for example, project into the arcs of Fig. 14c. If a deformation produces a simple rotation of fragments (or portions of a crystal) about an axis, the projected striae will lie along the latitude circles of a suitably oriented stereographic rotation net* as shown in Fig. 14c. The lengths of the projected striae in degrees of longitude indicate the angular range of crystallite orientation about the axis of rotation FF.**

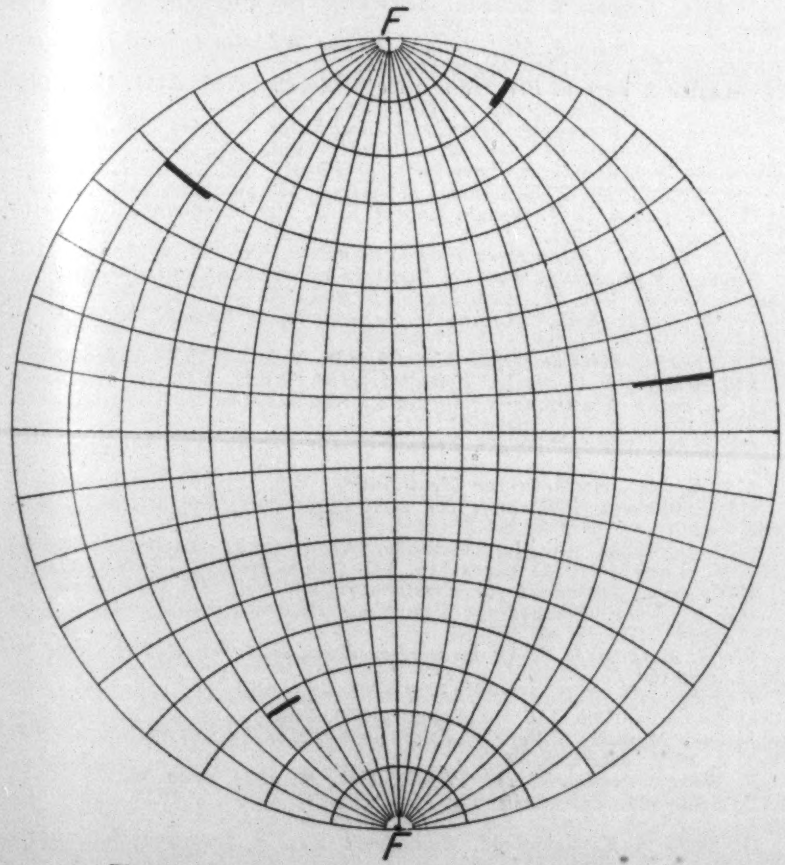

Fig. 14c. Stereographic projection of striae of Fig. 14b.

The nature of a preferred orientation of fragments or lamellae of a single crystal may be advantageously studied by such a projection even if the case is not one of simple rotation. Schiebold,[24] for example, shows a projection or "pole figure" for a distortion which produced combined radial and tangential spreading of Laue spots. Konobjewski and Mirer used stereographic projections to show that plastically bent rock salt crystals produce asterism that can not be explained by the assumption of pure rotation, since the arcs on the projection do not follow the latitude lines (Fig. 15) but deviate from them because of the elastic stresses in the bent lamellae of the crystals. Seljakow also uses the stereographic projection to study his elastic shear effect previously mentioned.

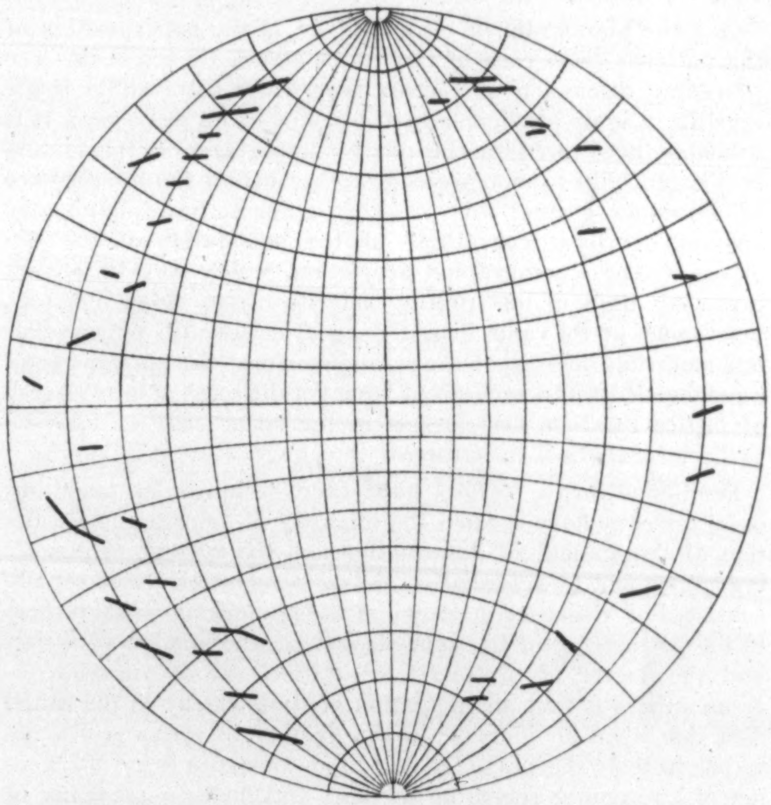

Fig. 15. Stereographic projection indicating the presence of elastic stresses in a plastically deformed rock salt crystal. (Konobjewski and Mirer)

It must be borne in mind in plotting a projection of a photogram showing asterism that the intensity distribution along a streak is a spectrum of the incident radiation (after it has undergone modification by the varying wave-length sensitivity of the emulsion—see Fig. 9—and by absorption in the specimen). Therefore only those striae for which a full range of wave-lengths is provided can represent the total range of angles actually present in the specimen.[44] The striae will stop abruptly at angles corresponding to reflection at the short wave-length limit of the spectrum, and will be weakened at their outer ends in accord with the lower intensity and the lower photographic efficiency at the longer wave-lengths. They may also show intense spots where the characteristic radiation from the target is reflected—as is commonly the case when a molybdenum target is used—and discontinuities in the blackening at the silver and bromine absorption limits. Thus the distribution of intensity in the striae is not proportional to the angular distribution of crystal lamellae.

If the axis about which lattice rotation has occurred is oriented so as to be parallel to the X-ray beam, the spots will be elongated circumferentially, as was first observed by Rinne.[25] In this case the striae are not interrupted by the discontinuities in the wave-length intensity curve, for only one wave-length contributes to each streak. A range of φ° in the lattice rotation will produce a spot φ° in length on the film; on the other hand if the rotation axis is oriented perpendicular to the beam, the reflected ray will be deviated 2° for every degree of rotation of the lattice. In a polycrystalline material

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*Such a net (the "Wulff" net) is a stereographic projection of a sphere with its latitude and longitude lines, the projection plane being one containing the poles of the sphere. References on the projection and net: A. E. H. Tutton. Crystallography and Practical Crystal Measurement, Vol. I. McMillan, London, 1922; E. Boeke. Die anwendung der stereographische Projection bei kristallographische Untersuchen. Bornträger, Berlin, 1913; S. L. Penfield. *American Journal of Science*, 1901, 1902; Ford's revision of Dana's Textbook of Mineralogy and other mineralogy texts.

**To use the conventional rotation net the axis FF must lie parallel to the plane of the projection; accordingly, a stereographic rotation of the arcs may first be necessary to acquire this orientation, that is, to bring the axis FF into the plane of the projection.

the rotation of the lattice within a grain will in general be about an axis intermediate between these extreme cases. Berg[45] points out that in such intermediate cases one can think of the rotation as the superposition of rotations about three mutually perpendicular axes, two axes normal to the beam and one axis parallel to the beam. The axes normal to the beam produce elongation of spots chiefly in the radial direction, while the axis parallel to the beam leads to circumferential elongation of spots. The greater number of the axes producing radial widening and the greater angle sensitivity of these explains why radial widening predominates over circumferential widening in Laue photograms of polycrystalline materials.***

Interpretation of Asterism with Polycrystalline Aggregates

A Laue photogram of an aggregate is the superposition of the patterns from each of the grains struck by the beam. The preceding discussion of factors that cause asterism in single crystals is again applicable to the grains of an aggregate. It is probable, however, that the relative importance of the factors is changed. Slip cannot proceed far because of the interference of adjoining grains; this probably reduces, for example, the amount of "local curvature" at the boundaries of the slip planes.[46] The stereographic projection, which may be advantageously used in interpreting asterism from single crystals, loses much of its value in analyzing asterism with polycrystalline materials because of the entanglement of the patterns from a number of grains, each grain having a different axis (or axes) of lattice rotation. Conclusions in the latter case must necessarily be statistical in nature.

Semi-quantitative results have been obtained by numerous observers who have studied the intensity of asterism as a function of the amount of deformation and the amount of annealing subsequent to deformation.[47] The observations have usually consisted of visual comparisons of the photograms with respect to the prominence of the spot elongation, the number of striae, and the degree of preferred orientation. As deformation increases there is first an elongation of spots chiefly in the radial direction, then an increase in the number of striae and a decrease in their sharpness leading to an almost uniform blackening of an annular region on the film, and finally a grouping of the striae into intense spots indicating a preferred orientation of the crystallites with steadily diminishing scattering in orientation. Upon annealing, no change in asterism is observed until recrystallization commences. Recrystallization brings about a sharpening of spots, with the grains sometimes forming a fiber diagram similar to the original one, sometimes forming a new one, and sometimes giving a wholly random distribution of spots, depending on the alloy, its previous deformation and annealing history, and the recrystallization temperature.

Fatigue stressing, as well as static stressing, causes slip and accordingly produces asterism;[48] extensive studies of this effect have not yet been made.

Laue photograms may be used on an object which has been cast, welded, drawn, rolled, stamped, etc., to compare the amounts of deformation the grains have undergone at different points. (See Clark[47] and Glocker[47].) The technique for such a study consists in cutting samples from the desired locations and reducing them to a thickness of 0.005" to 0.015" so that X-rays of ordinary wave-length can penetrate them. The cutting of the sample must be done with great care to avoid adding strains to the piece; the reduction in thickness may be carried out by grinding, etching, or turning on a lathe, but the final reduction is usually done by etching.*

A survey of an object by asterism photograms shows the distribution of what is frequently called "internal strain" in the object. The term is unfortunate, however, for it implies that the residual stresses in the object are measured, whereas, as we have seen, these stresses make only minor contributions to the asterism.

Summary

The Laue technique in the study of internal stresses has serious limitations. Quantitative measurement of stresses in bodies by the use of it is out of the question. Even as a qualitative indicator of stresses it is unreliable, for it confuses elastic strains with the complex lattice movements accompanying plastic flow. When plastic flow in a specimen has been appreciable, the effect of internal stresses on the Laue pattern is almost wholly submerged; in the absence of plastic flow the pattern may indicate elastic stresses, but in most cases this indication is so slight as to be rarely observed and only those stresses are detected which lead to inhomogeneous strain or bending of atomic planes in the small volume of material bathed in the X-ray beam. The Laue method has been more serviceable in the investigation of lattice orientation changes during plastic deformation and in the study of recrystallization than in the investigation of internal stresses.**

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***"Radial" is used here and is popularly used in connection with asterism in a rather qualitative sense, for the elongated spots are, in general, neither exactly straight nor exactly radial, as a glance at Leonhardt's curves will show. If the orientation of a crystallographic plane deviates in a random manner from a mean position—equal rotations occurring in all directions—the Laue spot from that plane will be elongated into an ellipse whose major axis is radial; the length of its major axis is to the length of its minor axis as $1 : \tan \Theta$. See W. L. Bragg, The Crystalline State, Vol. 1, Macmillan, 1934.

*Some of the labor of specimen preparation can be avoided by using a back reflection camera, though this is seldom done in Laue work as it involves longer exposure times. (F. Regler. *Zeitschrift für Physik,* Vol. 74, 1932, page 547). It may be seen from the geometry of the apparatus that back reflection Laue photograms are no more sensitive to asterism than photograms taken in the forward direction.

**Under a subsequent heading the intensity of reflection in Laue photograms will be discussed.

Properties of Ferrite As Revealed by Scratch Hardness Tests

Extended Abstract by H. W. Gillett

SCRATCH hardness determinations serve to determine the hardness of individual crystals or components of an alloy and hence offer advantages in metallurgical research possessed by no other type of hardness determination.

Prof. W. J. Crook of Stanford University has had two of his students, Miss Briggs and Mr. Williams, study ferrite grains by scratch hardness methods, in order to establish some properties of ferrite itself, separate from pearlite, while still dealing with steels that may contain pearlite.

Miss Briggs' thesis of 1933 reports a study of the scratch hardness method itself, as well as some work on ferrite.

Bierbaum, the chief proponent of the commercially available scratch hardness instrument, the "micro character," developed it primarily for study of bearing metals, and proposed that the scratch hardness number be computed from the reciprocal of the square of the width of the scratch. Miss Briggs shows that this method of computation has disadvantages and uses the width of the scratch directly as the hardness number. She finds that two loads, 3 grams and 6 grams, produce scratches of suitable width for all usual soft and hard metals and alloys, and hence sets up two microcharacter hardness ranges, M_3 and M_6.

The M_3 scratch width in microns is shown by study of a wide range of materials, to have a straight line relationship with the Rockwell E and B scales. Zero RE $= 45$ M_3; 100 RE $= 5$ M_3; and zero RB $= 17$ M_3; 100 RB $= 3.6$ M_3. Similarly, there is a straight line calibration between Rockwell C and M_6. Zero RC $= 12.6$ M_6; 65 RC $= 2$ M_6. Only one point on these calibration curves was out of line, that was for the RC and M_6 figures on a 13% Mn austenitic steel, where the formation of martensite under pressure might be expected to complicate matters.

It is pointed out that these relationships need hold only for such conditions that the Rockwell impressions are in individual, homogeneous crystals and where the scratch hardness is the same for different orientations of the crystal.

Scratch widths, read with an oil immersion lens of N.A. 1.32 are believed to be accurate to 0.1 micron and are recorded to 0.01 micron in order to establish the value in the first decimal.

Bierbaum's claim that squaring the load doubles the scratch width was not substantiated. The width with 6 grams ran on different materials, from 1.7 to 2.1 times the width with 3 grams. Other loads were investigated.

The diamond cutting point needs to be lubricated in order that the scratch may be uniform. A fulcrum watch oil is advocated by the makers of the instrument for use as standard lubricant. A light household lubricating oil or 80% Russian mineral oil diluted with 20% kerosene gave nearly as uniform results. Soap solutions were not satisfactory.

Reasonable care should be taken to have instrument and specimen level. The speed of scratching should be slower than 0.066 mm./sec. for materials softer than 60 RC; for harder ones, slower than 0.044 mm./sec.

The specimen should have a complete metallographic polish if its hardness is under 90 RB, should be finished with 0000 emery paper between 90 RB and 65 RC, while above 65 RC, finishing on 00 paper is sufficient. It is easier to distinguish the scratch if it is made perpendicular to the polish lines.

To remove metal flowed in polishing, light etching is recommended on specimens softer than 90 RB.

In measuring the width of the scratch, the microscope should be focused on the surface of the metal, not on the bottom or top of the cut. If the scratch does not remove the metal, but ploughs it into a furrow, the width is measured so as to include the distorted material. That is, the maximum width disturbed by the diamond point is measured, and the calibrations and comparisons with Rockwell figures are all made on this basis. Only one diamond point was used, the effect of variations in shape or sharpness of the point, which is supposed to be the corner of a perfect cube of diamond, were not studied, nor were duplicate readings by different observers made in order to determine the personal error.

It is concluded that the microcharacter is a laboratory rather than a commercial instrument.

Having studied the variables in the scratch hardness determination, Miss Briggs applied scratch hardness to a study of some properties of ferrite, expressing her results in terms of Rockwell C, through her calibration curve.

The hardness of ferrite away from pearlite and close to (within 5 microns of) pearlite was studied on three annealed steels: C. D. E.

Structure	Material	C	Mn	Si	S	P	RC, Away	RC, Close
A Normal	Armco Iron	.015	.02	tr.	.02	.005	...	...
B Banded	....	.21	.42	.15	.06	.07	...	...
C Normal	Casing Stock	.22	.39	.12	.05	.04	27.5	29.7
D Banded large grains	Sucker Rod Coupling	.29	.71	.14	.11	.16	29.6	43.7
E Banded	Bessemer Screw Stock	.12	.81	.02	.15	.10	26.0	38.0

Hardening of ferrite grains, taking the average of these away from, and close to, pearlite, was studied on the first four steels when water quenched at 100°F. intervals from 1000° to 1300°F., i.e., below the critical, with the following results:

	Hardness	Average	Ferrite Grains Only		Rockwell C
Steel	Annealed	Q 1000°	Q 1100°	Q 1200°	Q 1300°F.
A Normal	12	13.5	19	20.5	20.5
B Banded	23.5	29.5	32	38	35
C Normal	28.5	28	31	31	32.5
D Banded	33	37	40.5	42	42

In most cases the hardness values are averages of several hundred microcharacter readings. All 4 steels show an increase in hardness of ferrite on quenching below the critical, but C, a normal, open-hearth steel, does not change very much. Its banded, higher P counterpart, steel B, hardens much more and shows a notable jump in hardness at the 1200° quench.

The ability to harden and the variation in hardness of the ferrite close to and away from pearlite, is accounted for on the theory that cementite is in solid solution in ferrite, that the solubility increases with temperature up to a maximum at 1200°F., and that on account of greater distance for diffusion, the banded materials will show the greater differences in hardness of grains close to and away from pearlite. The effect of the differences in P, S, and presumably of N, in the different materials, is not discussed.

The effect on quenching on the near and remote ferrite grains was studied on steels C and D. Those closer to pearlite averaged less than one Rockwell C point harder in steel C for the four quenching temperatures, while in steel D, they averaged 7.5 points higher.

In his thesis of 1934, Mr. Williams carried on the work begun by Miss Briggs. He found that in the interim, the diamond point of the microcharacter had become chipped so that it produced a wider scratch. Calibration on Armco iron, as annealed and quenched by Miss Briggs, showed that under the 6 gram load the scratch was wider than in her work, by 20.5%, so this correction was made to his scratch widths to convert them to her widths and thence to Rockwell C numbers.

Materials for the work were made up in 200 gram induction furnace heats, small ingots being cast and forged down.

A series of carbon steels, called the "composite" series, was made up of the following compositions:

	C	Mn	Si	P	S
C 1	.21	.24	.23	.016	.053
C 2	.40	.43	.38	.014	.056
C 3	.50	.48	.52	.016	.039

These were made from a carbon steel base. The other series was made with an Armco iron base, and contained 0.004 to 0.009% P, 0.012 to 0.027% S, and except in 3 steels of a carbon series, 0.006 to 0.027% C. The compositions were:

Silicon Series	% Si	% Mn*
S-3	.03	..
S-4	.22	.01
S-5	.39	.01
S-10	.50	.01
S-9	.90	.02
S-7	1.02	.02
S-8	1.23	.02

*All furnace cooled from 1750°F.

Manganese Series	%Mn	%Si	Furnace Cooled from °F
M 1	.11	.16	1720°
M 2	.31	.17	1705°
M 3	.46	.27	1700°
M 4	.67	.23	1690°
M 8	1.15	.26	1690°

Carbon Series	%C	%Si	%Mn	Furnace Cooled from °F.
S6	.008	.06	.01	1750°
20	.20	.08	.01	1560°
40	.40	.08	.01	1480°
60	.61	.37	.02	1415°

By calculation from carbon and silicon analyses, corrected by inclusion count estimation of oxygen combined as SiO_2, on the basis of the equilibrium constant, it was assumed that a ferrous oxide series was also available containing Al, a sample without Mn or Si, as follows:

	% FeO	% C	% Si	% Mn*
A1	1.13	0.006	..	..
S1	.40	0.008	.04	..
S2	.13	0.008	.03	..
S3	.10	0.008	.03	..
S6	.05	0.008	.06	.01

*Furnace cooled from 1720°F.

The assumptions involved make the stated FeO content probably very far from accurate.

In these series, furnace cooling means that a ¼x½x1" specimen was held at temperature 30 minutes, then cooled to 400° F. in 2 to 2½ hours. "Slow" cooling means the cooling, after 30 minutes at temperature, of a ⅓x½x1" specimen packed in infusorial earth during both heating and cooling, to 400°F. in 11½ to 12½ hours.

The hardness values, in terms of Rockwell C, were as follows:

Manganese Series (0.16-0.27% Si, Except S6) Hardness R.C.

	% Mn	Furnace Cooled	Slow Cooled
S6	.01	11.1	11.3
M1	.11	11.1	15.7
M2	.31	12.6	...
M3	.46	16.8	...
M4	.67	18.8	20.3
M8	1.15	19.4	...

Silicon Series

	% Si	Furnace Cooled	Slow Cooled
S3	.03	11.1	...
S4	.22	11.3	11.5
S5	.39	15.2	...
S10	.50	16.2	...
S9	.90	18.2	18.9
S7	1.02	18.4	...
S8	1,23	18.4	...

Carbon Series (Hardness of Ferrite Only)

	% C	Furnace Cooled	Slow Cooled
S6	.008	11.1	11.3
20	.20	14.6	18.8
40	.40	17.8	21.0
60	.61	20.2	...

Composite Series (Hardness of Ferrite Only)

	% C	% Si	% Mn	Furnace Cooled
S6	.008	.06	.01	11.1
C1	.21	.23	.24	15.3
C2	.40	.38	.43	18.0
C3	.50	.52	.48	19.3

Ferrous Oxide Series (Ferrite Hardness)

	% FeO	Furnace Cooled
A1	1.13?	17.2
S1	.40?	13.7
S2	.13?	12.3
S3	.10?	11.1
S6	.05?	11.1

The conclusions are that Si and Mn harden annealed ferrite but little till they reach 0.3%, then the hardness rises rapidly, but from around 0.8% up to 1.2% there is not much further increase. 1% Mn hardens ferrite more than 1% Si. Carbon from 0.2 to 0.6% increases ferrite hardness almost linearly and much more than either Mn or Si. Addition of Mn and Si to ferrite already containing carbon has very little further hardening effect. The effects of the three elements are not additive, the C obscuring the effect of the others. It is thought that the presence of FeO hardens ferrite.

The study of specimens quenched below Ac_1 brought out the fact that it made very little difference whether a sample was repeatedly quenched from successively higher temperatures, 600°-1000°-1100°-1200° or 1300°F. (series quench) without intermediate anneal and furnace cooling, or was so annealed and cooled between quenchings. The greatest difference was at the 1200° or 1300°F. quench, and the change in ferrite hardness amounted to but 1 or 2 points Rockwell C, the specimens with intermediate anneal and furnace cooling showing the lower hardness. Nor did it make much difference whether the intermediate anneal was followed by furnace or by very slow cooling. The shape of the curves was similar. The increase in hardness, as quenching temperature was raised from 1000° to 1200°F. was quite close to linear. Differences were, however, shown at 1200° and 1300°F.

Hardness after the 600°F. quench was not appreciably changed from that in the annealed condition. It will suffice, then, to tabulate only the ferrite hardness after the 600°, 1200° and 1300°F. quenches of material that had had the usual anneal and furnace cool before the particular quench, omitting the data on the "series" quenched specimens and those very slowly cooled after the anneal before the quench.

				Ferrite Hardness, Rockwell C After Quenching from °F.		
	C	Si	Mn	600°	1200°	1300°
20	.20	.01	.08	14.7	20.9	20.0
40	.40	.01	.08	17.7	23.2	22.2
S6	.008	.06	.01	11.2	13.0	14.1
S4	0.010	.22	.01	11.8	13.2	13.3
M1	0.021	.16	.11	11.3	18.2	17.2
M4	0.024	.23	.67	18.5	22.2	21.2
S9	0.011	.90	.02	18.0	19.5	19.3

These ferrites were not hardened by quenching from 600°F., but were hardened by quenching from 1000° to1300°F., i.e., below Ac_1. The hardness always rose as the quenching temperature increased from 1000° to 1200°F. but continued to rise from 1200° to 1300° in only one specimen, S6. The samples with more than 0.01% Mn or 0.22% Si showed detectably lower hardness when quenched from 1300° than when quenched from 1200°F. The ability to harden on quenching from 1200°F. was greater with ferrite containing C or Mn than with that containing Si. The effect of Si is to harden both the annealed and the quenched ferrite by entering into solid solution. It is well accepted that C has very small solubility in ferrite at room temperature and thus allows precipitation hardening.

From this work Williams concludes that manganese acts similarly, by the separation of MnO particles. The hardening upon quenching is ascribed to supersaturation at 1200°F. of ferrite by Fe_3C and/or MnO, the supersaturated solution being retained on quenching. In the annealed and furnace cooled samples, the Fe_3C and/or MnO would be precipitated. When such material is reheated to 1200° for 30 minutes, most, but not all of the Fe_3C or MnO that could go into solution, says Williams, will go into solution, but the balance will start to agglomerate. On heating to 1300°, this agglomeration proceeds further and the amount of hardening compound held in forced solid solution on quenching from 1300° is then slightly less than that from 1200°.

This and some of the other theoretical discussions in the thesis on lattice strains and mechanical strains are rather involved and speculative. The observed data are interesting and useful. Whether the results could be directly interpreted in terms of commercial materials would depend somewhat upon whether the FeO and MnO equilibria set up in the making of a 200 gram heat in a few minutes in contact with air, without slag covering, are not too different from those met in practice.

The Time Factor

(Continued from page A 19)

financing method that will take away the smart of the high cost of outright purchase and let them be paid for in part out of fuel savings.

In the same category, but even more markedly so, come the factory-built metal house schemes, where beside the house itself, there are involved social, political and financing problems relating to cost and taxation upon the land upon which the house must stand, which apparently mean a more or less suburban location with attendent problems of gas, water and sewage service that must be solved concurrently with the architectural and metallurgical problems.

Such things are coming, but they will require a lot of parents and a period of gestation commensurate with their importance.—H. W. GILLETT

R. S. Archer has been appointed chief metallurgist of the Chicago district of the Republic Steel Corp. He was director of metallurgy for the A. O. Smith Corp.

Bertram David Thomas, a graduate of the University of Washington, and specializing in physical chemistry, has been added to the staff of Battelle Memorial Institute, Columbus, Ohio. His initial research on colloids is in the laboratories for dressing iron ores and coal preparation.

Victor Crosby, formerly foundry metallurgist for the Studebaker Corporation, has joined the metallurgical staff of the Climax Molybdenum Company as foundry metallurgist and will work out of the Detroit Office.

The Cooley Electric Furnace Company, Indianapolis, Ind., has appointed the Case Hardening Service Company as its representative in the Cleveland territory.

The readers of **Metals & Alloys** visiting the World's Fair will find a 3-phase, 500 lb. Lectromelt furnace in daily operation in the Ford Building.

ORE CONCENTRATION (1)

JOHN ATTWOOD, SECTION EDITOR

Points of Interest at Kalgoorlie and Leonora. *Proceedings Australasian Institute of Mining & Metallurgy,* No. 91, Sept. 1933, pages lxxi-cxxx. Includes discussion of crushing, milling, roasting, grinding and treatment at Great Boulder Proprietary, South Kalgurli Consolidated Ltd., and Associated Gold Mines of W. A. (New) Ltd.; description of the bromo-cyanide treatment process and flow sheet at Boulder Perseverance Limited, the flow sheet, including flotation and treatment, at the Lake View and Star Limited and brief notes on ore treatment at the Golden Horseshoe (New) Limited, Hannan's North G. M., Sons of Gwalia Limited, and Messrs. A. Victor Leggo & Co.'s arsenic plant, Wiluna. AHE (1)

General Description of the Wiluna Gold Mines Ltd., Wiluna, W. A. *Proceedings Australasian Institute of Mining & Metallurgy,* No. 91, Sept. 1933, pages cxxxi-cliv. Crushing, grinding, flotation, filtering, roasting, cyaniding, precipitating and smelting at Wiluna are described. AHE (1)

Crushing, Grinding & Plant Handling (1a)

Ore Dressing. Some Progress Even with Curtailed Operations. Charles E. Locke. *Mining & Metallurgy,* Vol. 14, Jan. 1933, pages 32-33. Review of the improvements made in ore dressing equipment during 1932. VSP (1a)

Electric Winding and Coarse Crushing Plant at No. 7 Shaft, Broken Hill South Limited. G. B. Game. *Proceedings Australasian Institute of Mining & Metallurgy,* No. 91, Sept. 1933, pages 267-315. Pages 301-315 describe the crushing plant. AHE (1a)

Review of Fine Grinding in Ore Concentrators. Alexander M. Gow, Morris Guggenheim & Will H. Coghill. *United States Bureau of Mines, Information Circular* No. 6757, Jan. 1934, 29 pages. The fine-grinding practice in 49 concentrators in the United States, Alaska, Canada, Mexico, and Cuba is reviewed. The methods of operation, grinding capacities, and milling costs for 470 ball, rod and pebble mills are tabulated. AHE (1a)

The Economical Improvement of Crushing Plants. G. J. Brown. *Crushing, Grinding, Mining & Quarrying Journal,* Vol. 2, Jan.-Feb. 1934, pages 117-118. General. AHE (1a)

Homestake Metallurgical Practice. E. Walter Adams. *Mines Magazine,* Vol. 24, Jan. 1934, pages 9-12. Description of the practice employed by the Homestake mills, resulting in a 94.5% extraction on a low grade ore at a very low cost. From jaw crushers the ore is passed to the stamp mill and from there to the rod mill. Data on weight, life, and kind of iron or steel used for stamp parts are given. Dealing with the amalgamation process, the Clark-Todd amalgamator is discussed which recovers 45-50% of the Au in the ore. From the amalgamator the pulp flows into the classifier and overflow passes over 12 silver amalgamation plates which recover an additional 10-12% of the Au. The further treatment involves besides the usual equipment Dorr classifiers, rubber lined tube mills, Hardinge mills, and Dorr thickener. Dealing with sand leaching, data concerning air, leaching, draining, and wash water periods are furnished. The cyanide consumption varies, the average being ¼ lb. NaCN per ton of sand treated. All solutions are precipitated by the Merrill-Crowe process. Slime treatment by adding lime and Merrill filter presses are discussed. Refining. Crude bullions removed from the retort are melted down in graphite crucibles with a little borax to remove any pyrite and sand. Kz (1a)

Nickel Cast Iron in Relation to Crushers. *Crushing, Grinding, Mining & Quarrying Journal,* Vol. 2, Jan.-Feb. 1934, page 130. The value of Ni-Cr addition to white cast Fe is discussed. AHE (1a)

A Portable Crushing and Grinding Plant. *Crushing, Grinding, Mining & Quarrying Journal,* Vol. 2, Jan.-Feb. 1934, pages 114-116. A self-contained tractor crushing and fine grinding plant is described. AHE (1a)

Gravity Concentration (1b)

Classification and Tabling of Alabama Red Iron Ores. B. W. Gandrud, A. C. Richardson & B. S. Followill. *United States Bureau of Mines, Report of Investigations,* No. 3224, Mar. 1934, 7 pages. Alabama red Fe ore requires fine grinding to free the Fe oxide from gangue. It slimes badly in grinding, and the slimes are only slightly higher grade than the ore. They contain too much of the Fe to reject, but are not amenable to gravity concentration. A simple flow sheet is proposed: Crushing and grinding to 14 mesh, desliming, classifying and tabling separately the product from each spigot and the underflow from the cone dewatering the classifier overflow. Middlings are returned to the grinding circuit. Table concentrates + the overflow from the deslimer and the dewatering cone are combined as a final concentrate. The grade of concentrate and percent extraction increase with grade of ore. If the ore contains more than 35% Fe a satisfactory concentrate with reasonably good extraction can be expected. AHE (1b)

Flotation (1c)

An Investigation into the Mechanical Efficiency of Impellers for Machines Working the Flotation Process. T. A. Read. *Proceedings Australasian Institute of Mining & Metallurgy,* No. 91, Sept. 1933, pages 377-396. With constant peripheral impeller speed, power increases with increasing diameter of impeller. Depth of pulp in the cell has a marked effect upon power and upon the volume of air drawn into a flotation cell; for the experiments described, power increased or decreased 0.24 kw. for each rise or fall of 6 in. in water depth. An impeller 18 in. in diameter is most efficient as measured by volume of air/min./kw. hr. Increasing impeller speed varies power consumed as the 2.03 and 3.71 powers of the speed at the lower and upper limits respectively, average 2.62. Increase in sp. gr. of pulp in cell is directly proportional to increase in power consumption. Minimum power at a given impeller speed occurs when the cover plate diameter is not less than the diameter of the impeller. AHE (1c)

Depressing Primary Slime During the Flotation of Gold in Milling Ores. E. S. Leaver & J. A. Woolf. *United States Bureau of Mines, Report of Investigations,* No. 3226, Mar. 1934, pages 17-26. Finely divided metallic Au occurring in milling ores floats readily and a high-grade Au concentrate can be made by flotation if no interfering slime or gangue is present. Any good collector may be used for Au flotation, but organic collectors of the xanthate type produce a cleaner, higher-grade concentrate than coal tar-creosote oils. Talcose or carbonaceous slime floats readily and ordinary dispersing agents, such as Na silicate, are not effective in keeping it out of the concentrate. A protective colloid wets out this type of slime and destroys its tendency to float. Clayey slime does not float readily, but it remains in suspension and coats particles of valuable minerals, making it difficult to obtain good selectivity during flotation. Proper deflocculation of the pulp improves results. Slimes of Fe and Mn oxides generally cause excessive reagent consumption and low recovery. Such a pulp must be kept dispersed; improved results are obtained by using a depressing agent. Hematite causes no trouble. Starch is the most effective agent for depressing primary slime; it should be added as a solution to the ore pulp. It acts first on slime; if excess is used, metallic sulfides and Au will be wetted out. AHE (1c)

ORE REDUCTION (2)

Non-Ferrous (2a)

A. H. EMERY, SECTION EDITOR

Direct Recovery of Metals from Sulphide Copper Ores, with Special Reference to Mansfeld Copper Schist (Über die Gewinnung von Metallen unmittelbar aus sulfidischen Kupfererzen unter besonderer Berücksichtigung des Mansfelder Kupferschiefers) C. Krug, C. Groetz & R. Huber. *Metall und Erz,* Vol. 30, Dec. 1933, pages 469-480. Laboratory tests showed that sulphides of Cu and Fe heated to 600°-800°C. in a reducing or inert atmosphere form metallic Cu, Cu_2S, and FeS. Fe, which combines with the S liberated by the CuS, controls Cu formation. Fe can be added as finely divided metal or oxide. At 900° and higher the reaction reverses. CuS can be treated with a reducing gas at 600°, but the reaction is slow. The best temperature for reducing pure CuS in the absence of Fe is 900°. If metallic Fe is added gas is not necessary for the reduction providing the materials are finely divided and intimately mixed. When an inert gas and Fe_2O_3 are used only 2.3%-2.4% of S goes off as SO_2. In tests made with Cu schist ore using Fe_2O_3 but no gas, 85%-92% Cu was recovered. By treatments at 600°-800° for 6-10 hrs. the size of the Cu particles was increased 10-12 times. The process has commercial possibilities. 9 references. CEM (2a)

Electrolytic Copper (La Technique du Cuivre Electrolytique) M. Altmeyer. *Cuivre et Laiton,* Vol. 6, Mar. 30, 1933, pages 135-143. The entire field of production of pure Cu (at least 99.85%) is discussed and electrolytic methods are reviewed. The different metallic impurities are classified according to their effect on the electrolysis and the methods of recuperation or removal are described in detail. The treatment of Cu ores often depends on the origin of the deposit. In some cases, Cu can be deposited directly as finished products, for instance in tubes, by rotating cathodes; a brief description of such process is given. Ha (2a)

Notes on Purification of Electrolytes in Copper Refining. E. S. Bardwell & R. J. Lapee. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 512, Nov. 1933, 12 pages. Describes process used at Butte. As and Sb are the most troublesome impurities. When the Sb in the anodes exceeds the As the electrolyte does not have to be purified as frequently as when the As exceeds Sb. Formerly, the electrolyte was concentrated in a Pb-lined tank containing steam coils; now it is concentrated in pans heated by gas. The pans are made of a steel containing 28% Cr and 0.6% Ni. Welded pans of this material failed at the weld and the pans now are made from a single folded and riveted sheet. After evaporation, $CuSO_4$ is crystallized from the solution. The solution is then electrolyzed with insoluble anodes. Fe and Ni are removed later if necessary. JLG (2a)

Electrolytic Zinc from Fume Produced from Trail Lead Blast-Furnace Slags. H. W. Hannay & James Bryden. *Transactions Canadian Institute of Mining & Metallurgy,* 1934 (in *Canadian Mining & Metallurgy Bulletin* No. 263, March) pages 141-164. ZnO fume analyzed Ag 1.2 oz./ton, Zn 61.0%, Pb 15.6%, Cd 0.04%, Sb 0.230%, As 0.037%, Sn 0.05%, Ge 0.02%, Cl 0.005%, S (as sulfate) 1.3%, SO_2 0.35%, Cu trace, and Co trace. Amts. of impurities present alone in $ZnSO_4$ solutions necessary to cause loss of current efficiency are, in milligram per liter: Sb 0.15, Ge 0.15, Te 0.5, Se less than 1.0, Sn 3.0, As 5.0, Co 10.0, Ni 12.0, Bi 20.0, Cu 30.0, Fe 70.0, In harmless up to 50.0, and Fl no effect. Amounts below critical concentration may be beneficial. In purification, $Fe(OH)_3$ is precipitated and removes As, Sb, etc. Treatment with Zn dust and small amounts of $CuSO_4$ at elevated temperatures removed other toxic elements. Fl in the solutions caused excessive corrosion of the Al cathodes and methods for its removal are discussed. The oxide leaching plant is described. AHE (2a)

Manufacture of Beryllium (Über die Darstellung von Beryllium) H. E. Martens. *Die Metallbörse,* Vol. 23, Nov. 11, 1933, pages 1438-1439. Experiments of Jahn, Kangro, Fischer & Peters on manufacturing Be are reported. The reaction $3\ BeCl_2 + 2\ Al = 2\ AlCl_3 + 3\ Be$ could not be translated into a commercial process due to the highly dispersed state of the exceedingly reactive metal. The product mainly consisted of Be oxide representing about 80-90% of the metal yield expected. It is not likely that this will replace the commercial Stock-Goldschmidt process. EF (2a)

Ferrous (2b)

Present Developments of Smelting (Évolution actuelle de la Sidérurgie) A. Portevin. *Usine,* Vol. 43, Mar. 29, 1934, page 31. General trends are discussed. Ha (2b)

Improved Auxiliaries Effect Blast Furnace Economy. *Steel,* Vol. 94, Jan. 1, 1934, page 120. Developments in blast furnace practice and equipment during 1933. Include beneficiation and conservation of materials, new type of steel bottom for hot-blast stoves, increasing efficiency of hot-blast stoves by application of refractory inserts, and improved blast-furnace filling equipment. MS (2b)

Review of Blast Furnace Practice. Owen R. Rice. *Blast Furnace & Steel Plant,* Vol. 22, Jan. 1934, pages 34-36, 46. In 1933, "fanning" gave way to regular blowing at moderate or even light pressure. Cheaper ferrous materials, such as flue-dust, were used successfully. Quality of pig-Fe was improved. Flue-dust losses were reduced by incorporation in the stack of an upwardly expanding section above the stock-line. Encouraging results have been obtained in investigations of disintegration of brick linings and of the manner in which tuyères burn. There was expanding use of automatic mud guns, Ward-Leonard system of control applied to skip hoists, and stock-line recorders. A device was developed for automatically assuring an unvarying volume of coke in a skip. Pressure stove burners with individual blowers and all-electric control are receiving much attention. A new primary gas washer was developed. MS (2b)

Blast Furnace Developments in 1933. Wm. A. Haven. *Blast Furnace & Steel Plant,* Vol. 22, Jan. 1934, pages 27-28. There were few new developments in design, equipment, or operating practices in 1933. The only new installations are a new electric gas cleaner and a new type of gas valve. Lack of innovations is due to past slowness of the industry generally in adopting improvements; increased attention to conservation of materials; uncertainty resulting from government supervision; and continuance of subnormal consumption. MS (2b)

Blast Furnace Progress in 1933. A. J. Boynton. *Blast Furnace & Steel Plant,* Vol. 22, Feb. 1934, pages 96-97. There were no striking new developments in 1933, but the practice of partial and slow rate of operation of the furnace has resulted in a number of economies. Sintering and classification of raw materials and standardization of conditions within the stock column are receiving increased attention. MS (2b)

Blast Furnace Operation for Foundry Pig Iron (Der Hochofenbetrieb auf Giessereiroheisen) B. Osann. *Die Giesserei,* Vol. 21, Mar. 30, 1934, pages 129-131. Former and present furnace operation is compared; the shortening of the melting period has increased temperatures on the hearth and absorption of C by the molten Fe above the saturation point. Ha (2b)

Filling Equipment for Blast Furnace Steps Up Output. E. C. Kreutzberg. *Steel,* Vol. 94, Mar. 26, 1934, pages 48, 50. Describes improved automatic equipment recently installed at a number of stacks in the Magnitostroy district, Russia, with particular attention to charging of coke. It is intended for use where capacity of a furnace is to be increased from 600-800 tons per day to 1200-1500 tons. System comprises a hoisting mechanism and motor, together with controls for interlocking this with other equipment in the blast-furnace unit. Amount of material charged has been increased largely by speeding up the skip. MS (2b)

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MELTING, REFINING & CASTING (3)

Processing of a Double-Sided Pattern Plate by Means of a Metal Pattern (Herstellung einer doppelseitigen Modellplatte unter Verwendung eines vorhandenen Metallmodells) Hugo Hollweg. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Dec. 24, 1933, pages 535-546. Detailed discussion of the procedure. GN (3)

Training of Molders (De la Formation de la Main d'Oeuvre Ouvrière en Fonderie) J. Leonard. *La Fonderie Belge,* Vol. 2, Jan. 1933, pages 5-13. Methods of training molders as practiced in Belgium are reviewed. Plan is proposed to improve foundry education of workers. FR (3)

Rapid-Molding Devices (Schnell-Formeinrichtungen) U. Lohse. *Zeitschrift Verein deutscher Ingenieure,* Vol. 78, Jan. 13, 1934, pages 56-58. Automatic operation of compressed air tamping and molding presses, and several other mechanical devices speed molding operations, increase foundry capacity and reduce scrap. Ha (3)

Tinned Scrap in the Blast-Furnace Charge. E. J. Fox. *Iron & Coal Trades Review,* Vol. 128, Feb. 2, 1934, page 211. The use of scrap from cans, detinned and otherwise, in blast-furnaces, is not objectionable in the iron produced if used in small quantities. The effect on the analysis of the pig-iron due to the use of this scrap has been usually to reduce the P content. Increased consumption of canned foods has made this source of scrap abundant. Ha (3)

Molding Sands. Second Part (Introduction a l'Étude des Sables de Moulage, Deuxième Partie—Les Propriétés d'Utilisation) L. F. C. Girardet. *Bulletin de l'Association Technique de Fonderie,* Vol. 7, Nov. 1933, pages 435-445. A continuation of a study of molding sands, the first part having been published in the same Bulletin, 1933, pages 43-60. The first problem in testing molding sand is to obtain results under conditions analogous to those existing in the mold, tests and methods discussed are: 1. Apparent specific gravity; 2. Change of volume under pressure; 3. Cohesion; 4. Dry cohesion; 5. Cohesion after burning. 23 references. WHS (3)

Combination of Lifting Motion of Stripping Plate with the Pulling-Through Motion of Loose Parts of Patterns in Molding Machines with Lifting Carriage (Verbindung der Abhubbewegung des Abstreifkamms mit der Durchzugsbewegung loser Modellteile bei Abhebeformmaschinen) F. Brobeck. *Die Giesserei,* Vol. 21, Jan. 19, 1934, pages 29-30. Description of the machine and method for molding patterns of various shapes with steep sides. Illustrated. Ha (3)

New Molding Board Frame (Neuer Modellplattenrahmen) F. Brobeck. *Die Giesserei,* Vol. 21, Jan. 5, 1934, pages 5-6. The frames and molding boards are so arranged that they can easily be interchanged so that a greater flexibility in castings for quantity production is obtained with a smaller number of molds. Ha (3)

Devices for Removing Patterns or Pattern Plates from the Mold (Vorrichtungen zum Ausheben von Modellen oder Formplatten aus der Form) F. Brobeck. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Jan. 7, 1934, pages 4-6. Defects that may be imparted to molds of large dimensions when pattern is removed manually are first discussed. Three different types of lifting devices are described: (1) rigid device for lifting large gear patterns, (2) lighter device for lifting pattern plates or patterns, (3) similar device to (2) but heavier. GN (3)

Core Bearings and Core Fixing (Kernlager und Kernsicherungen) F. Vogelsang. *Die Giesserei,* Vol. 20, Dec. 22, 1933, page 570. Methods for placing cores in the molds in proper position and for keeping them in place are described. Ha (3)

New Ways in Sweep Molding. Sweep Molding of a Parted Mold with One Spindle (Neue Wege in der Schablonenformerei. Schablonieren einer geteilten Form mit nur einer Spindel) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Dec. 24, 1933, pages 536-538. Paper first discusses disadvantages of common method which uses 2 spindles, and then enumerates advantages resulting in molding with but 1 spindle and describes device developed by Freitag Co., Olpe, Westfalia. Use of the apparatus is illustrated; chief advantages are cheapness and great accuracy. GN (3)

Non-ferrous Materials Affect Casting Design. *Machine Design,* Vol. 5, Apr. 1933, pages 23-25. Discussion: R. A. Bull, May 1933, page 36. Fundamental suggestions relating to the design of non-ferrous castings as proposed by the Committee of Recommended Practices, Nonferrous Division, American Foundrymen's Association, are considered under the following headings: draft, shrinkage, parting lines, locating points, dry sand cores, green sand cores, finishing, section uniformity, joining sections, minimum section thickness, bosses and lugs, fillets, ribs, pockets, metal inserts, welding and soldering. WH (3)

The Testing of Green Sands. *Metal Industry,* London, Vol. 43, Aug. 11, 1933, pages 131-133. A discussion of routine methods proposed by the Institute of British Foundrymen, relating to permeability, standardizing of sieve sizes, measurement of pressures and moisture. Ha (3)

Molding by Sweep of Branch Pipe Vertically Arranged to Main Spindle (Schablonieren rechtwinklig zur Hauptspindel liegender Stutzen mittels Schablone) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Jan. 21, 1934, pages 37-39. When casings or cylinders with lateral branches are molded sweep and auxiliary patterns are so constructed that only one spindle is required. For a tube 1000 mm. in diameter with lateral branch 600 mm. in diameter another method is described in which the branch is also molded by sweep. A corresponding cross-piece is then required on sweep spindle. GN (3)

Pressure Molding (Le Moulage sous Pression) Nielsen. *Usine,* Vol. 43, Jan. 25, 1934, page 37. Describes method and machinery operating under air pressure of 6 kg./mm.^{2}. Ha (3)

Action of Coal Dust in Molding Sand (Die Wirkungsweise des Kohlenstaubes im Formsand) M. Paschke & Eugen Schneider. *Die Giesserei,* Vol. 21, Apr. 13, 1934, pages 149-151. The quality of the casting skin as dependent on wall thickness of castings, grain size and amount of C dust, humidity of molding sand and casting temperature was studied. The best grain size of C dust was found to be equal to the grain size of the sand. The thicker the wall the more C dust must be added. The action of C is due to its softening which starts at about 400°C. and forms a protective envelope on the sand grains. The tests are described in detail. 7 references. Ha (3)

Recent Development in Cupola Practice in Great Britain (Développement Récent dans la Pratique du Cubilot en Grande-Bretagne) J. G. Pearce. *Bulletin de l'Association Technique de Fonderie,* Vol. 8, Feb. 1934, pages 45-51. Complete description of the "balanced blast cupola." A lower set of tuyeres is equipped with valves. Two or three rows of smaller upper tuyeres open from the same blast belt. Opening or closing the valves on the lower tuyeres changes the proportion of the blast passing through the upper and lower tuyeres. One or more of the valves may be closed in order to melt out any accumulation of slag before the tuyeres. Advantages claimed for this type of cupola are: (1) 25% to 40% lower coke consumption; (2) higher temperature in the melting zone; (3) less oxidation of the metal; (4) less frozen slag over the tuyere entrances; (5) hotter metal at the end of the heat. See also *Metals & Alloys,* Vol. 3, Apr. 1932, page MA 107. WHS (3)

Supervision and Standardization in the Foundry. Paul R. Ramp. *Iron Age,* Vol. 133, Feb. 8, 1934, pages 12-15. Stresses the importance of practical experience for successful foundry supervision. Men who through many successes and failures become experts in molding, core and pattern making, melting and sand mixing, should be better qualified to keep pace with rapid strides of foundry progress. Standardized methods of foundry practice are essential. VSP (3)

Pattern Data According to Drawing (Modellangaben nach Zeichnung) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Mar. 4, 1934, pages 103-105. Discusses special case of container for gas engine where drawings are utilized to present visually the mold arrangement. GN (3)

Loam Cores (Noyautage de formes en Terre) Technical Committee Belgian Foundry Association. *La Fonderie Belge,* Vol. 2, Feb. 1933, pages 27-29. Article gives details of manufacture of large cores having a rectangular section. Methods of sweeping as well as inside construction reinforced with metal frame are explained. FR (3)

Study of Shrinkage (Etude du Retrait) Scientific Committee Belgian Foundry Association. *La Fonderie Belge,* Vol. 3, Sept. 1933, pages 125-135. Generally speaking shrinkage is noted in three different ways: (1) Castings have size smaller than that of pattern, (2) castings may show shrinkage cavities, (3) internal stresses can exist within castings. When a casting is in equilibrium state, there is a definite distant d between any 2 molecules of the metal. If the metal is heated molecular attraction is lowered and distance between 2 molecules increases and becomes greater than d. When heating is very high attraction can be lowered to a point when metal reaches liquid state. During cooling, molecules can be arranged so that distance between 2 of them is d (equilibrium) is less than d (compression stresses) or greater than d (tension stresses). Examples are given of castings in which each state is reached. Work of Bauer published in 1926, on deformations of cast Fe members of various size, is discussed. Following section of article deals with piping. (1) If cooling was the same in each point of the metal, casting would be compact and would be of smaller size than the pattern. (2) At the beginning external part of the casting in contact with mold cools more rapidly than inside portion, after a certain time the reverse is true so that cooling rate is not constant neither in space nor in time. (3) Outside part freezes giving a solid crust whereas inside portion remains liquid. (4) Since freezing appears with volume decreasing, shrinkage cavities are liable to form within the casting. (5) Differences of cooling rate cause internal stresses. Solidification and pipe formation are studied for various types of ingots. In last section, liquid contraction, freezing contraction and solid shrinkage are dealt with as well as complications due to evolution of gases during freezing. FR (3)

Grain Sand Structure and Mold Permeability Control. Harry W. Dietert & Frank Valtier. *Iron Age,* Vol. 132, July 27, 1933, pages 11, 64. See "Grain Structure Control Insures Mold Permeability Control," *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 123. VSP (3)

The Theories of Corrosion. O. A. Knight. *Mineral Industries, Pennsylvania State College,* Vol. 3, Nov. 1933, pages 2, 4; Dec. 1933, pages 2, 4; Jan. 1934, pages 3-4; Feb. 1934, pages 2, 4. The author reviews the following theories of corrosion: the acid, film, peroxide, direct O attack, colloidal, biological, and electrochemical. Soil corrosion and methods for combating atmospheric corrosion are discussed. AHE (13)

Patterns and Patternmaking. E. Longden. *Association of Manchester Engineers, Transactions* Session 1932-33, pages 149-191. Pattern making and pattern shop machinery, economy in the shop by selecting the right kind of pattern to be made, section patterns, skeleton patterns and skeleton core boxes, sweep molding, templets, etc. are discussed and illustrated by many examples. See *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 329. Ha (3)

Treatment and Preparation of Green Foundry Sands (Traitement et Préparation des Sables de Moulage à Vert) G. Itam. *Revue de Fonderie Moderne,* Vol. 28, Feb. 10, 1934, pages 31-35. Good castings in green sand require that the different parts of the mold be repaired without breaking under the tool. The sand renders all lines of the pattern in true shape, patterns can be taken out without damage to the mold, cores have sufficient rigidity, that the sand is not eroded under the action of the live metals and that the gas can escape freely. In order to prevent the sand from adhering to the casting and from vitrifying a suitable powder is applied, graphite, etc. The preparation and treatment of sands from these points of view is discussed. Ha (3)

Study of Molding Sands (Étude des Sables de Moulage) R. Guerin. *Revue de Fonderie Moderne,* Vol. 28, Mar. 10, 1934, pages 63-66; Mar. 25, 1934, pages 81-85. Natural and synthetic sands, preparation for use, choice of composition for definite purposes, installations for automatic handling of sand in the foundry, are discussed. Ha (3)

Notes on Pressure Molding (Quelques Notes au Sujet du Moulage sous pression) G. D'Ardigny. *Revue de Fonderie Moderne,* Vol. 28, Feb. 25, 1934, pages 45-49. The mechanism of molding under pressure is explained and the forces available for manual and machine molding are discussed. The pieces which can be molded have a definite limit according to the pressure available; for instance in manual pressure molding with one arm only exerting the pressure (40 kgcm.) the maximum size is 20 cc., with hands and body 100 kgcm. Arrangement of pressure channels and of molds, shrinking of metal and removal of pieces is described. Ha (3)

A New Type of Pattern Table (Un nuovo Tipo di Placca Modello) Dino & N. Piva. *Industria Meccanica,* Vol. 16, Feb. 1934, pages 101-103. Describes a plate with perforations on which patterns can conveniently be arranged and fastened. Ha (3)

Mold Press Base in Four Part Flask. Pat Dwyer. *Foundry,* Vol. 61, Dec. 1933, pages 10-12, 42. Describes the production of printing press base by the Chandler & Price Co., Cleveland, in a four part flask and all green sand mold. VSP (3)

Foundry Progress During the Depression. *Iron Age,* Vol. 131, June 15, 1933, pages 934-938. Gives a description of some of the new materials and processes, and presents comments by various authorities. The topics discussed are: "Heat treatable gray iron casting"; "New alloy castings appear"; "Steel foundry activity"; "Seek higher malleable specifications"; and "New aluminum alloys." VSP (3)

Core Blowing. *Mechanical World & Engineering Record,* Vol. 95, Mar. 16, 1934, pages 251-252. Explanation of the working principle and method of operation of the Augusts-Borrmann machine. Cores produced by the new blowing process are strong and light. Any type of sand can be blown, both oil and clay bonded. A production example is 10,000 cores a week. Kz (3)

Mold Gear Wheels on Machines. *Foundry,* Vol. 61, Oct. 1933, pages 10-12, 42. Describes special machines used in production of gear wheel molds. Each machine is equipped with index plate and changeable gear trains to accommodate gear molds between certain definite size limits. Only pattern equipment needed is the tooth block which governs the size, shape and style of tooth, and possibly 1 or 2 sweeps to form faces on cope and drag, also a corebox to form arms and hub for one type of wheel, or web for another. Gives details of method of procedure. VSP (3)

Control Sand in Malleable Foundry. Charles Morrison. *Foundry,* Vol. 61, Dec. 1933, pages 14-15, 47, 49. See "Sand Control on a Continuous Molding Unit in a Malleable Foundry," *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 121. VSP (3)

World Foundry Congress of Paris 1932 (Congrès Mondial de Fonderie de Paris 1932) L. Persoz. *La Revue Industrielle,* Vol. 63, Mar. 1933, pages 151-154. A short abstract of each paper read at the Congress is given. FR (3)

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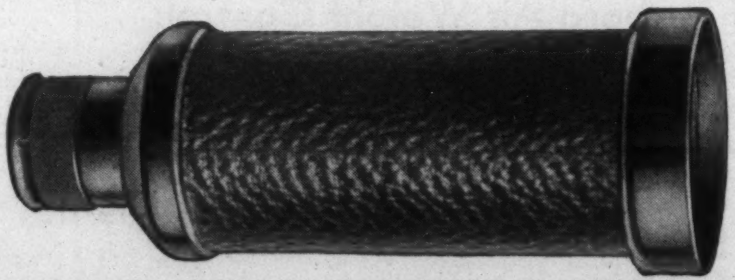

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Non Ferrous (3a)

G. L. CRAIG, SECTION EDITOR

Remelting Aluminum in the Reverberatory Furnace (Das Umschmelzen von Aluminium im Flammofen) E. T. Richards. *Chemiker-Zeitung,* Vol. 58, Feb. 14, 1934, pages 135-136. The use of the reverberatory furnace for remelting Al is not as common as the crucible or pot furnace, and it must be used with great care. A product of good quality can be obtained from low grade scrap if the metal is protected from oxidation and the absorption of furnace gases, H, N and CO_2. The hearth should be deep and the surface of exposed metal small in proportion to the weight of the metal. For an 8-ton charge the depth should be 60 to 70 cm. The lining must be basic. Oil or gas are preferable to coke as fuel, as better control of furnace atmosphere can be obtained. Al does not oxidize appreciably up to 750° C., but above that oxidation and absorption of N rise sharply. If Al is not oxidized it does not absorb N, and if it does not contain N it will not absorb CO_2. To prevent oxidation the Al should be charged into a furnace containing some molten metal, the temperature must not rise over 750°, the atmosphere must be strongly reducing, but clear, to prevent CO_2 absorption, a proper flux must be used, and the metal must be properly charged and tapped. The best flux is $ZnCl_2$ and NH_4Cl. $NaCl + 15\% CaF_2$ or NaCl + cryolite are also used. The flux should cover the metal until it is poured. The addition of an oxidizing flux, such as a bichromate, shortly before tapping cleans the metal. It must then be treated again with $ZnCl_2$ to deoxidize. Al is sometimes held for 12-15 hours at low temperature, covered with flux, to effect coalescence of nonmetallic impurities. CEM (3a)

Removal of Arsenic and Antimony from Copper by Furnace-refining Methods. W. J. Hillenbrand & H. C. Kenny. *Transactions American Institute Mining & Metallurgical Engineers, Copper Metallurgy,* Vol. 106, 1933, pages 483-486. Chemical analyses have failed to disclose the presence of Sb in Lake Cu. Sb has been found in the soda-ash slags from the As-removing operation, from 0.0027 to 0.0069%. The As-Sb ratio was from 1600:1 to 980:1. Sb was added to heats in a small furnace and the rates at which As and Sb were removed determined. Sb as well as As was removed by the soda, but the rate of As removal was greater than the rate of Sb removal. In no case, however, was the ratio of As removed to Sb removed so great as 1000:1. It is evident that the final Sb content of Cu treated to remove the As is below 0.00001%. JLG (3a)

Waste-heat Boiler Practice at Miami. P. D. I. Honeyman & P. A. Faust. *Transactions American Institute Mining & Metallurgical Engineers, Copper Metallurgy,* Vol. 106, 1933, pages 251-254. Describes equipment and operation. JLG (3a)

Note on the Influence of Gases in an 8% Copper-Aluminium Alloy on Normal and Inverse Segregation. I. G. Slater. *Journal Institute of Metals,* Vol. 54, 1934, 3 pages (Advance copy); *Metal Industry,* London, Vol. 44, Mar. 9, 1934, page 276. Alloys containing different amounts of gas were cast into 3x3-in. cylinders in sand molds. The ingots containing much gas were prepared by poling with green wood. Measurements of porosity and analyses of drillings taken from surface and center showed that as the gas content, measured by porosity, increased the type of segregation changed from normal to inverse. Ha + JLG (3a)

The Boliden Deposit (Boliden-Förekomsten) *Teknisk Ukeblad,* Vol. 81, Mar. 8, 1934, page 158. A resume of Oscar Falkman's address before the Norwegian Engineering Societies (N.I.F.) on Feb. 23, 1934. Describes the smelter and refinery at Rönnskär, Sweden. Ore roasted in 12 hearth furnaces and a 2 m. diam. roasting kiln, 27 m. long. The calcine is smelted in 3 reverberatory furnaces, 5.5x28 m., the largest in Europe. Bessemer copper with 98% Cu is cast into anodes and electrolyzed. The anode slime produced contains 5% Au, 12.5% Ag, and 45% Cu; it is roasted with soda to convert selenium into sodium selenite and selenate which are dissolved in water. The residue is leached with H_2SO_4, dissolving Cu and part of Ag, leaving Au with some Ag and Pb, which is leached with NaOH. The residue from the last leach is cast into anodes and electrolyzed with $AuCl_3$-solution. Dissolved Ag is precipitated with Cu and cast into anodes and electrolyzed in acid nitrate solution. About 40,000 tons As_2O_3 and some bismuth are recovered from the smelter gases. Capacity of the plant 6,000 tons Cu, 6,500 kg. Au, and 18,000 kg. Ag. BHS (3a)

Factors in the Solidification of Molten Metals. Sydney W. Smith. *Metal Industry,* London, Vol. 44, Feb. 23, 1934, pages 205-209; Mar. 2, 1934, pages 255-257. Metal may be brought to the desired condition in the furnace with respect to composition, temperature, gas content, etc., but the quality of the casting is governed to some extent by the transference of the metal to the mold. Gas may be absorbed or inclusions formed in this short interval. Methods for producing the desired results are discussed at length. Cu-Ag and Al-Si alloys are discussed as examples of type alloys. Ha (3a)

Die-Casting Leads to Reduction in Manufacturing Cost. H. K. Wooton. *Modern Machine Shop,* Vol. 6, Sept. 1933, pages 7-10. Manufacture of dies and molds for quantity production is discussed. Ha (3a)

Developments in Converting Lead and Copper Matte at Tooele. B. L. Sackett. *Transactions American Institute Mining & Metallurgical Engineers, Copper Metallurgy,* Vol. 106, 1933, pages 132-139. Describes practice at plant of International Smelting Co. Pb matte is converted with Cu matte. Changes in practice introduced in 1927 have resulted in decreased conversion costs. The Pb matte analyzed 8.6% Cu, 15.7% Pb, and 2.0% Zn. The Cu matte analyzed 27.1% Cu and 7.8% Pb. JLG(3a)

Waste-heat Boiler Practice of Nevada Consolidated Copper Corporation. N. W. Sager & H. W. Mossman. *Transactions American Institute Mining & Metallurgical Engineers, Copper Metallurgy,* Vol. 106, 1933, pages 237-245. Describes equipment and operation. JLG (3a)

Sands for Non-Ferrous Foundries. A. B. Searle. *Metal Industry,* London, Vol. 44, Jan. 12, 1934, pages 69, 73. A brief review on preparation of foundry sands, binders and revivers, control in handling and mixing. Ha (3a)

Development and Use of Anaconda Electro-sheet Copper. William M. Shakespeare. *Transactions American Institute Mining & Metallurgical Engineers, Copper Metallurgy,* Vol. 106, 1933, pages 441-448. Sheet weighing 1 oz./ft.^{2} is made by plating with insoluble anodes on a revolving drum. About 175 lb. of Cu are deposited on each drum in a day. For a sheet 31 in. wide this represents a length of 1120 ft. The thickness of the original sheet can be increased to almost any thickness desired by plating in a bath through which the sheet is passed in a series of dependent loops. Anodes of crude Cu are used in building up the thin sheet and plating is on only 1 side of the sheet. Many details of the processes are described. One side of the sheet is smooth and the other side has a mat surface. The material is used in conjunction with felt, insulting board or other substances in making roofing materials. It is mounted to a nonmetallic material by means of asphalt. JLG (3a)

Die-Cast Pistons. *Automobile Engineer,* Vol. 23, May 1933, pages 161-164. Piston division of the Birmingham Aluminum Casting Co., Ltd., is described. Cu-Mg alloy is used for motor car pistons and is cast between 700° and 720° C. Pistons are heat treated to a Brinell hardness of 125-150. The design of aluminum alloy pistons is discussed and modern foundry practice discussed. RHP (3a)

Casting of a Diaphragm of Aluminum, 2600 mm. in Diameter (Giessen einer Blende aus Aluminium mit 2600 mm. Durchmesser) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Jan. 7, 1934, page 15. Diaphragm was molded in 2 parts with sweep and auxiliary patterns. Moulding procedure is described in detail. GN (3a)

On the Sorption of Hydrogen by Reduced Nickel. I. Determination of the Quantities of Hydrogen Adsorbed by and Diffused in Pure and Spoiled Reduced Nickel and Determination of the Isothermal Adsorption. SCHUN-ICHIRO IIJIMA. *Scientific Papers Institute of Physical & Chemical Research, Tokyo,* Vol. 22/23, Dec. 1933, pages 285-300. (In English.) Tests on pure Ni prepared by reduction of Kahlbaum's pure Ni nitrate and on Ni "spoiled" by air. Absorption of H by reduced Ni is attributed to adsorption and diffusion. The diffused and adsorbed H quantities can be determined separately. Isothermal adsorption curves gained on reduced Ni at low pressures coincide with those of Freundlich. The adsorption heat of 16,350 cal. has been calculated by using Crapayron's formula and the numerical values of the isothermal adsorption curves. Quantities of H adsorbed by a "spoiled" reduced Ni (air was allowed to enter the highly evacuated vessel at 400°C. until the pressure reached 1.3 cm.) were quantitatively measured and the adsorption heat evaluated yielded 6,479 cal. When reduced Ni is in contact with air, the points or spots on the metal surface which are highly active are spoiled by the air. The O thus combined with the metal cannot be removed even by heating the sample in a vacuum to 400°C. WH (3a)

On the Development of the Electric Smelting Industry (Litt om den Elektriske Smelteindustris Utvikling) REIDAR BJUNE. *Teknisk Ukeblad,* Vol. 81, Mar. 1, 1934, pages 136-138. Deals principally with the development of the Söderberg electrode. Gives description of the mechanical arrangement and the latest types of casings and contacts used. Among the advantages are given reduced cost of operation; no interruptions in furnace operation; lower power consumption and better electrical arrangement; eliminates hot and difficult operation of changing electrodes; permits the use of larger furnaces. Today the largest electrode in use has a diameter of 2.4 m. The Söderberg electrode is now being used extensively in the production of aluminum. Here it has made possible the use of one, two, or three electrodes in a furnace, whereas with the old type of electrode a furnace would require 12-20 electrodes. In this case the casing must be made of aluminum, and a material without ash, such as petroleum coke, must be used in the preparation of the electrode mass. Very good results have been obtained. Furnaces up to 38,000 amps. have recently been put in operation. The large modern furnaces are inclosed so that the fluor-bearing furnace gas may be washed and thus rendered harmless. BHS (3a)

Electrolytic Copper Refinery of Ontario Refining Company, Limited, at Copper Cliff, Ontario. FREDERICK BENARD. *Transactions American Institute Mining & Metallurgical Engineers, Copper Metallurgy,* Vol. 106, 1933, pages 369-397. The furnace equipment, electrolytic plant, Ag refinery, and auxiliary equipment are described. The electrolytic plant contains 1230 concrete tanks arranged in 32 sections. The capacity is 20,000,000 lb. of Cu per mo. JLG (3a)

Smelting Copper Concentrates in a Converter. GEORGE E. BEAVERS. *Transactions American Institute Mining & Metallurgical Engineers, Copper Metallurgy,* Vol. 106, 1933, pages 149-150. Gives data on operation of Pierce-Smith converters used at Tennessee Copper Co. Concentrate is charged with the matte, the concentrate to matte ratio being about 0.7. Net Cu recovery is 97%. JLG (3a).

Waste-heat Boiler Practice at the Anaconda Reverberatory Plant. E. A. BARNARD & GEORGE TRYON. *Transactions American Institute Mining & Metallurgical Engineers, Copper Metallurgy,* Vol. 106, 1933, pages 230-236. Describes equipment and operation. JLG (3a)

Copper-refinery Waste-heat Boilers at Great Falls Reduction Department, Anaconda Copper Mining Company. E. S. BARDWELL. *Transactions American Institute Mining & Metallurgical Engineers, Copper Metallurgy,* Vol. 106, 1933, pages 225-229. Describes equipment and operation. JLG (3a)

A Modern Copper Refinery in Canada (Sur une Raffinerie de Cuivre moderne au Canada) M. ALTMEYER. *Cuivre et Laiton,* Vol. 7, Jan. 15, 1934, pages 7-12. The works of the Canadian Copper Refiners Ltd. in Montreal-East are described. Ha (3a)

The Equilibrium of the Reaction between Steam and Molten Copper. N. P. ALLEN & T. HEWITT. *Engineering,* Vol. 135, Mar. 31, 1933, page 363; *Metal Industry,* London, Vol. 42, Mar. 17, 1933, page 303. See *Metals & Alloys,* Vol. 5, Jan. 1934, page MA 30. LFM + Ha (3a)

The Fire Refinery of British Copper Refiners, Limited. C. H. ALDRICH. *Transactions American Institute Mining & Metallurgical Engineers, Copper Metallurgy,* Vol. 106, 1933, pages 467-482. Describes plant recently installed in England. Blister Cu is fire refined to high-conductivity material. The capacity is 2500 tons of refined Cu per mo. JLG (3a)

Casting under Pressure (Généralités sur la Fonderie sous Pression) A. BRIZON. *Bulletin de l'Association Technique de Fonderie,* Vol. 7, Nov. 1933, pages 422-435. Survey of methods, machines and metals for castings made under pressure. Base metals for such castings are Pb and Sn, Zn, Al, Cu, and Mg. Castings made by this method may not be as cheap as others, but have the following advantages: 1. Require little or no machining; 2. Have high precision and interchangeability; 3. May have other metals inserted; 4. Uniform quality; 5. Casting equipment requires small space and fewer workers are required. WHS (3a)

Calculation of Charges in Metal Founding (Gattierungsberechnung in der Metallgiesserei) ERICH BECKER. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Feb. 18, 1934, pages 76-78. Discusses in a few examples calculation of non-ferrous metal charges for attaining economic founding. Various types of charges in making alloys containing 81-83% Cu, 7-9% Sn, 6-8% Zn and 3-5% Pb are considered. GN (3a)

Porosity in Non-Ferrous Metal Castings. G. L. BAILEY. *Metal Industry,* London, Vol. 44, Mar. 16, 1934, pages 293-296. The causes of shrinkage in castings are discussed, i. e. contraction of the liquid metal when cooling to the freezing point and then solidifying, and the further shrinkage when cooling to the ambient temperature. Evolution of gases is a further cause of porosity, or entrapped gases, due often to poor design of the mold. Inert gases are used for degasification, such as N, Cl, titanium tetachloride, etc. Ha (3a)

Production of Copper Castings of Very High Conductivity in Sand. Deoxidation by Beryllium (La Preparation de la Fonte de Cuivre au Sable à tres haute conductibilité. Desoxydation par le Beryllium) *Cuivre et Laiton,* Vol. 7, Jan. 15, 1934, page 12. Be is said to be the only deoxidant which gives sand castings of copper a high thermal and electric conductivity. While P gives an electric conductivity of 44%, use of Be makes it possible to obtain 52-54%. Pure electrolytic Cu should be used and melted in the crucible under a layer of borax and charcoal (about 250 g. borax for a charge of 80 kg. Cu). Melting temperature should be about 1150° C. When the Cu is molten an alloy with about 10% Be is added for deoxidation. Pouring should be done at 1100°; after pouring the casts should be covered with fine charcoal or sand. The sand for the molds should contain about 7% water and have good gas permeability. Cores must be dried very carefully. Ha (3a)

Recent Progress in the Centrifugal Casting of Non-Ferrous Alloys. FR. W. ROWE. *Metal Industry,* London, Vol. 44, Mar. 2, 1934, pages 245-250. The inherent defects of ordinary sand castings, i.e., slow rate of solidification, low density, large grain size, poor physical properties can be eliminated very largely by centrifugal casting whereby a cast metal of high density, soundness and small and uniform grain size can be obtained. A comparison of 2 castings of gunmetal (84% Cu, 8% Sn, 4% Pb, 4% Zn) showed a yield point of 10.4 tons/in.^{2} when sand cast, and 13.2 tons/in.^{2} when centrifugally cast; the maximum stresses were 13.2 and 20.0 resp., elongation was 17% in each case. An Al bronze of 89.4% Cu, 0.19% Si, 0.08% Fe, 10.19% Al showed a maximum stress of 35.2, a yield point of 8.8 tons/in.^{2}, elongation of 28% and an Izod impact of 25 ft.lb. Castings made in this manner show smaller variations in properties, and due to higher values and greater accuracy as to shape, weight can be saved. Ha (3a)

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Modern Electrolytic Refining. *Metal Industry,* London. Vol. 43, July 21, 1933, pages 51-52. General remarks on the current efficiency of the cathode in electrolysis and electrolytic separation of metals from dissolved and molten salts; modern practice has shown that the better the electrodes are protected from the electrolyte the higher the cathodic current efficiency. Chief losses are found to arise from the volatility of the metal itself at high temperatures, from diffusion of the anode product to the cathode, and the reaction of the metal with atmospheric O in the furnace. These conditions are discussed briefly for Pb, Zn, Mg and Al. Ha (3a)

Casting of Corrix Metal (Das Giessen von Corrix-Metal) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Feb. 4, 1934, pages 55-56. Corrix metal, a recently developed German corrosion resistant alloy, containing 88.25% Cu, 8.7% Al, 3.05% Fe as made by a special method is distinguished by the ease with which it can be successfully cast into intricate shapes. Tensile strength: 61.6 kg./mm.^{2}; elongation, 20-30%, reduction of area 32%, Brinell hardness, 194. Melting point about 1080° C. Melting, casting and subsequent treatment is considered. Field of application is outlined. Corrosion resistance of Corrix metal reaches almost that of austenitic Cr-Ni steel. GN (3a)

Molding and Casting of a Pump Body of Bronze (Formen und Giessen eines Pumpenkörpers aus Bronze) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Jan. 21, 1934, pages 35-36. Detailed discussion of molding and melting procedure for a bronze containing 79.2% Cu, 10.2% Sn, 9.5% Pb, 1.1% P. Pump body was molded and cast in vertical position which is best method to obtain sound casting. GN (3a)

The Role of Investment Setting Expansion in Gold Compensation Casting Techniques. E. W. Skinner. *Dental Cosmos,* Vol. 75, Oct. 1933, pages 1009-1018. The expansion of investments (plaster of Paris and silica) during setting as a means of compensating for the shrinkage of gold castings was studied. The expansion was attributed to increase in temperature due to exothermic chemical reactions and to the setting. These changes increase with increase in amount of plaster and are influenced by the amount of water used and time of mixing. Excessive heat softened and distorted the wax pattern. S. concludes that it is safer to avoid, insofar as possible, changes in the wax pattern due to setting expansion and to compensate for the gold shrinkage by thermally expanding the mold for casting. OEH (3a)

Deoxidizers for Brass Alloys. Charles Vickers. *Foundry,* Vol. 61, Jan. 1933, pages 51, 54; Feb. 1933, pages 26-27; *Cuivre et Laiton,* Vol. 6, Oct. 15, 1933, pages 475-478. Mg as deoxidizer reduces the fluidity of brass alloys and therefore is not used as extensively as P. Mg and P may be used together without detriment to metal. Describes the preparation of the alloy. When Al or Si are used in yellow brass castings of high Zn content, it is generally known that casting made in this manner will not withstand pressures, even moderate pressures expected of plumbing fixtures. P is a better deoxidizer for this type of metal. Gives test data. Ha + VSP (3a)

Aluminum Castings Without Impurities (Aluminiumguss ohne Verunreinigung) *Aluminium,* Vol. 15, Aug. 31, 1933, pages 5-6. A new method of obtaining Al or Al-Fe castings with minimum contamination by impurities consists in pouring the molten metal in an atmosphere containing C and Cl either in free state or as compounds; Cl can be in the form of an organic Cl-containing compound in solid, liquid or gaseous form. The best is a combination of Cl and CO_2; due to their high specific gravity these chlorated hydro-carbons fill the mold easier and last longer. Methods of application are described. Ha (3a)

New Casting Machine for Anode Plates and Bars of Copper (Eine neue Giessmaschine zum Herstellen von Kupfer- Anodeplatten und Kupfer- Barren) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Sept. 3, 1933, pages 367-368. Description of new casting machines for above mentioned purpose manufactured by the Demag Co., Duisburg, Germany. The casting machine for anode plates has a rated capacity of 20 tons/hr. GN (3a)

Casting Small Hand Wheels of Aluminum in Iron Molds. (Kleine Aluminium-Handräder in Kokille Giessen) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Sept. 3, 1933, pages 368-369. Discussion of casting and molding practice which insures round castings. Importance of casting temperature, mold temperature, high purity raw materials and gas removal are stressed. GN (3a)

Separation Melting of Gold, Silver and Copper Scrap (Das Abtreibschmelzen von Gold-, Silver- und Kupferabfällen) E. Raub. *Mitteilungen des Forschungsinstituts and Probieramts für Edelmetalle,* Vol. 7, Apr. 1933, pages 4-8. Separation melting is essentially a process in which metal scrap, particularly in rare metals, is melted with the addition of certain fluxes which contain niter as an effective reagent. The action of the latter is to cause the base metals in the melt, especially those easily oxidized, to be slagged. This method is particularly useful with low-carat gold scrap or filings. The specific procedures for Au, Ag and Cu are described in detail. Ha (3a)

Considerations and Suggestions on the Use of Brass Scrap in the Foundry (Considération et Conseils sur l'Emploi en Fonderie des Déchets de Laiton) *Cuivre et Laiton,* Vol. 7, Mar. 30, 1934, pages 127-129. Competition makes necessary the use of scrap in brass foundries in ever increasing degree. Selection and treatment of scrap are, therefore, of great importance to obtain a satisfactory sound product. Sheet brass contains usually from 62-70% Cu and 38-30% Zn, sometimes Pb up to 2%. Fe and moisture in the scrap should not exceed 4%, Fe alone not more than 1%. Al, Mn and Pb are not permissible for good brass castings. The amount of scrap to be used depends on kind of scrap: light scrap, as sheets and chips 30%, heavy pieces, 40%, and scrap which has already been melted to ingots of known composition, 50-60%. Literature on this subject is reviewed. Ha (3a)

Uncle Sam's Gold Warehouse. *Metal Industry,* N. Y., Vol. 31, June 1933, pages 210-211. A description of the new assay office in New York City is given. PRK (3a)

Melting Procedure of Silver-Cadmium Alloys (Zur Schmelzbehandlung von Silber-Kadmium Legierungen) *Die Metallbörse,* Vol. 24, Feb. 3, 1934, page 147. Cd is added (5-25%) to Ag used for Ag castings. The volatilization losses can be cut down to 0.15% Cd if Cd is melted in a large graphite crucible, covered with charcoal and Ag heated slightly above its m.p., and quickly poured over the molten Cd. The Cd-Ag alloys must be cast at a temperature slightly above the m.p. The casting becomes porous if the pouring temperature is only 20°C. too high. Protection against the poisonous Cd vapors must be provided for. EF (3a)

Slag Mixtures for Working up of White Metal Scrap (Schlackenmischungen für die Verhüttung von Weissmestallabfällen) *Die Metallbörse,* Vol. 24, Jan. 27, 1934, page 116. A mixture of 200 pts. crushed C, 100 Fe scale, 75 sand, 50 fluorspar, 50 lime and 15 calcined soda are suggested. The slags of the ore reducing industry are out of question. The slag forming ingredients should be as low as possible to cut down metal losses. A maximum content of 25% soda is admitted. The slag mixture should amount to 5% of the total charge and thorough mixing is urged. EF (3a)

Die Casting Alloys Are Refined; Machines Made More Productive. *Steel,* Vol. 94, Jan. 1, 1934, pages 131-133. Reviews progress in the die-casting industry during 1933. Outstanding was higher purity of Zn-base alloys; casting of more intricate shapes and thinner sections; more extensive casting of Mg and brass; more rapid rate of production; a new type of pressure casting machine; and an improved die steel for Al casting. MS (3a)

The Alfred David Lenz System of Lost Wax Casting. Compiled by H. F. Lenz and others. National Sculpture Society, New York, 1933. Cloth, 7x10 inches, 37 pages. Price $1.50. Lenz was an artist who not only designed but personally cast many statuettes of great artistic merit. To produce the fine detail in these difficult castings, he developed a special technique, much of which died with him. His executors have tried to piece together from his notes and the few molds existing at his death, some explanation of his methods. The result is interesting but rather disjointed.

His recipe for modeling wax, the investment of the model with dental plaster and silica, the gating, and venting, the removal of the wax by steaming and then washing out with hot mercury, the backing of the investment with asbestos cement and its baking are described.

An ingenious scheme was worked out for coring the casting instead of casting it solid. Cotton on a wire support, connected to a brass pipe vent also serving as anchorage for the core, with a thin layer of investment over the cotton was placed inside the wax model (a slush-casting made from a plaster cast of the solid model) conforming roughly to the cavities but not filling them.

Then more investment was poured in to fill the cavity, thus providing a core with a compressible center.

The warm invested mold after drying was set in fine gravel or coke particles contained in a "flexible flask," with an asbestos lined rubber wall and bottom. The mouth of the mold is luted into a tapered opening in the top of the mold. A suction pipe connected to a 20″ vacuum extends into the gravel or coke filling.

At the moment the molten metal is dumped into the mold, the flask is evacuated through the pipe by stepping on a valve, causing the rubber walls to contract and force the fine gravel or coke filling into close contact with the outside of the mold, to compress the mold and prevent it from cracking as the metal freezes and the casting contracts within the mold. This, combined with the compressible core, is thought to be one of the secrets of the quality of Lenz's castings.

An alloy of 93% Cu, 7% Al was a favorite of his, another contained 85% Cu, 10% Al and 5% Sn. Rather vague comments are included on production of patina on such alloys. Some discussion is added, but no real details given on the casting of an object with different parts of different alloys, first making one part of the highest melting alloy, providing lugs or flanges for anchorage, inserting this in the mold and casting the lower melting alloy upon it.

Lenz also made castings with actual flowers and leaves as patterns, probably by freezing before investing with dental plaster and magnesia, and then burning out the vegetable matter and blowing out the ash. Full details are lacking, but success was doubtless dependent on the use of the flexible flask.

While Lenz combined the artist and the foundryman in one, it would appear that with this book as guide, a foundryman could have a lot of fun trying to cast from models made by some artist friend, if the artist would stand for the loss of the models while the foundryman was experimenting. The foundryman would probably learn a lot that would be useful in larger scale work. H. W. Gillett (3a)-B-

Electrical Equipment on the Mount Lyell Mining Field, Tasmania. Thomas Arthur C. Preston. *Journal Institution of Engineers of Australia,* Vol. 6, Jan. 1934, pages 23-31. Paper also includes detailed description of electrolytic Cu refinery and presents plant data. WH (3a)

The Metallurgy of Mercury (Sulla metallurgia del mercurio) P. Principato. *La Metallurgia Italiana,* Vol. 26, Jan. 1934, pages 13-18. Italian practice is compared with up to date practice. The most economical method of refining, where ore enrichment methods are impractical, is as follows: 1) grinding and partial drying of the ore; 2) roasting in a continuous furnace; 3) precipitation of the dust in a "hot-treater"; 4) condensation in Cr-steel condensers; 5) condensing chamber, also made of Cr-steel; 6) a Cottrell "cold-treater"; 7) Cr-steel aspirators. AWC (3a)

Advance in Die Casting Technique (Fortschritte in der Spritzgusstechnik) Ernst Praetorius. *Forschungen & Fortschritte,* Vol. 10, Apr. 1, 1934, pages 134-135. The following advances during the last years are discussed (1) increase of the number of metals utilized in die casting, (2) structural improvements of die casting machines with the aim of raising output and improving quality, (3) manufacture of heavier and thick-walled castings. The early failures with Zn alloys are partly ascribed to the poor quality of the Zn brand employed. Al bearing Zn alloys are cheap and strong. Sn bearing Zn alloys show remarkable chemical resistance and favorable tolerance values. About 50% of die castings are Zn alloys. In spite of its high melting point, Al alloys containing Cu, Si, Ni, Mg, Mn, etc., are successfully die cast and utilized in aviation, automobile and machinery industry. Hot press casting of brass recently attained great commercial significance. Working speed and pressures have been consistently stepped up. Higher pressures yield denser and stronger castings. 10-20 castings/min. are possible at present. Al castings of 8 kg., 1 m. length and 2.5 mm. wall thickness have been successfully cast. 30% savings and more are possible if a large tonnage is available. Simple molds cost 200-3000 R.M., complicated ones up to 20,000-30,000 R.M. Wear of molds can be avoided entirely. EF (3a)

Melting Stereotype Metal by Immersion Gas Heaters. S. E. Phillips. *Printing Equipment Engineer,* Vol. 46, Sept. 1933, pages 13-14. Technical details and discussion of economy of equipment that enables control and automatic maintenance of the temperature of the molten metal. Kz (3a)

Artists and Engineers Cooperate in Production of Die Cast Hardware. J. B. Nealey. *Iron Age,* Vol. 131, May 11, 1933, pages 740-742. Describes the making of Zn alloy die cast automobile hardware at plant of the Devereaux Corpn., Detroit. Artists design the sets to harmonize with new car models, in consultation with die designers. The average compositions of the alloys used in addition to Zn are:

	Al	Cu	Mn
Zamak—2	4.10	2.70	0.03
Zamak—3	4.10	------	0.04
Zamak—5	4.10	1.00	0.03
Zamak—6	4.10	1.25	------

Zn alloys are cast at temperatures ranging from 750°F. to 850°F. Melting is done in a Ni cast Fe pot which sets in gas-fired furnace of refractory material, steel incased, and metal is run into gooseneck, from which it is forced into dies. Wide range of metal finishes may be had. One of the difficult castings made is the carburetor body used on Ford V-eight. VSP (3a)

Production of Aluminum Ingot Metal from Scrap Equal to New Metal (Die Erzeugung von neuwertigem Aluminiumblockmetal aus Abfällen) H. Reininger. *Die Giesserei,* Vol. 21, Mar. 16, 1934, pages 115-119. Utilization of Al scrap to economize in new metal, especially in foundries, is discussed and a schedule is developed to show how scrap from different sources should be collected, stored, sorted and treated to obtain a material from the melting furnace that is fully equivalent to virgin metal. Ha (3a)

Notes on the Design of Die-Castings. F. A. W. Livermore. *Metal Industry,* London, Vol. 44, Mar. 30, 1934, pages 341-343. Advantages and disadvantages of die-casting are discussed in general. While rapid production and good finish together with improved mechanical properties and uniformity of products are outstanding advantages it is economical only for large production, more than 500 pieces. The method is not suitable for large castings. An important factor is the cleanliness of the process, absence of dirt and dust. For metals with low melting points, as Pb, Sn, a die made from a good grade tool steel will last indefinitely, as many as 30,000 castings can be produced before the die cracks; for Al and its alloys specially heat-treated alloy steels are used, cracks develop after from 5,000 to 20,000 castings. Cr-V steels are preferably used. The die surfaces are lubricated now and then with mixture of lard-oil, beeswax and graphite; this facilitates removal of castings and protects die faces. Ha (3a)

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Metallurgical Treatment of Brass Scrap Containing Iron (Zur metallurgischen Behandlung eisenhaltiger Messingabfälle) Werner Fröhlich. *Die Metallbörse,* Vol. 23, Nov. 24, 1933, pages 1406-1407. Fe bearing brass scrap should be treated by the following methods: (1) elimination of larger Fe parts by mechanical or magnetic methods, (2) careful melting down and taking off of the unmelted Fe scrap, (3) protection of the bath against C during the melting process, (4) elimination of Fe in solution and decomposition of Fe carbide by proper slag treatments. Metallic Fe is soluble in Cu and brass but not Fe carbide. The latter appears in castings close to the skin and impairs machineability. These hard enclosures are not Fe-Zn compounds as erroneously assumed heretofore. The absence of C during the melting process must be strictly insured. Glass or sand-soda layers as protection against oxidation and clay or magnesite crucibles should be employed. The flame must be oxidizing. Some foundry men add copper scale instead of deoxidizers. Fe carbide is eliminated by additions of Al or by oxidizing slags mainly based on sulfates of alkalines and earth alkalines (K_2SO_4). Slags tending to scorify Fe are mixtures of sand and calcined soda (1:1). In order to oxidize Fe first, 20% Cu scale is included. The potassium cyanide and Hg chloride methods are also suitable but develop poisonous vapors. A mixture of 75% calcined soda, 18.5% KCN and 6.5% SiO_2 is stirred into the bath. The author doubts the efficiency of utilizing strongly volatile Hg-chloride suggested by American foundry men. EF (3a)

The Mechanism of Inverse Segregation. Owen W. Ellis. *Transactions & Bulletin, American Foundrymen's Association,* Vol. 4, Dec. 1933, pages 347-369. Defects apparently resulting from the presence of inclusions of gaseous or solid non-metallic elements or compounds encountered in bronze foundry alloys of the 89-11 type are discussed. Physical phenomenon instead of chemical phenomenon is used to explain porosity and inter-crystalline cavities. With a comparatively high rate of heat transfer across the mold-melt interface the temperature gradient within the melt and the surface of the mold increase. A system of capillaries extending from the center to the skin of the casting and filled with tin-rich liquid is formed. It is suggested that the phenomenon of inverse segregation is manifested in those portions of the capillary system where the least surface energy is required for the formation of contraction cavities. The fact that the vapor pressure of the melt at the ends of the capillaries is always less than at the center of the system decreases the likelihood of the formation of contraction cavities in its more constricted portions. The result will be that the tin-rich liquid in the system will be concentrated in the peripheral cavities, while the central capillaries become filled with contraction cavities. See also *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 125. CEJ (3a)

Molding of Bronze (Le Moulage du Bronze) Detourmignies. *Revue de Fonderie Moderne,* Vol. 28, Feb. 25, 1934, pages 54-59. Characteristic properties and compositions of molding sands in general and those best suited for bronze molding, molding processes, avoidance of internal stresses by uniform cooling, and molding machines are discussed. Ha (3a)

Copper Alloys (Les Alliages Cuivreux, Influence de Perte au Feu sur les Prix de Revient, Considération Générales sur le Fusion et la Moulage du Bronze a Vert) A. Brizon. *Bulletin de l'Association Technique de Fonderie,* Vol. 8, Jan. 1934, pages 2-8. Gives formulas for the calculation of cost which include melting losses, scrap castings, and other factors. Discussion of casting bronze in green sand-patterns, sand, melting, pouring, and cleaning. Three elementary principles in melting are: (1) always pour on ascending curve of temperature, (2) pour metal as cold as possible, (3) reach the pouring temperature as rapidly as possible. WHS (3a)

Investigation of the Gas Content of Electrolytic Zinc (Untersuchungen über den Gasgehalt von Elektrolytzink) Werner Burmeister & Max Schlötter. *Metallwirtschaft,* Vol. 13, Feb. 16, 1934, pages 115-120. During the electrolysis of Zn in acid solution Zn and H are formed simultaneously at the cathode. The H content of Zn from solutions of 10^{-5} to .5*N* acidity decreases with increase in current density. This is explained by the course of the current density-potential curves of Zn deposition and of H formation on Zn. Zn deposits with minimum H content are obtained from still electrolytes. Agitation increases the H absorption. With constant current density the H content increases as the acidity of the electrolyte is increased. The H content does not decrease after storing for several weeks at room temperature. When Zn is distilled in an atmosphere of H at .01 mm. Hg pressure it absorbs considerable H during condensation. Under higher pressure very little or no H is absorbed. 7 references. CEM (3a)

Non-Ferrous Foundry Ingot Shapes. Pierce Barker. *Metal Industry,* N. Y., Vol. 31, May 1933, pages 166-167; June 1933, pages 204-205; Sept. 1933, pages 302-303; Vol. 32, March 1934, pages 89-91. A description of conditions to which ingots must conform. They are: Sales attractiveness, shape, analysis and physical properties, freedom from surface defects, soundness, color, notches, uniformity, condition, size and weight, ease of pouring, ease of removal from mold, compactness, handling, stacking. PRK (3a)

Spinning Babbitt in Motor Bearings. H. J. Beadle. *Transit Journal,* Vol. 78, Mar. 1934, page 91. A centrifugal babbitting machine developed in the shops of the Dallas Railway & Terminal Co. produces denser bearing metal, homogeneous and free from pores and blowholes. 30% longer life is claimed over those produced from mandrels. The machine, which is illustrated, has two vertical plates, welded on a base plate, which carry ball bearings in which are mounted a shaft with a pulley. A third vertical plate welded to the base carries a large ball bearing which supports the flanged end of the bearing shell—the other end being held in a chuck mounted on an extension of the driving shaft. For cooling, after pouring, a stream of compressed air is directed against the outside resulting in a smooth surface of the metal. WHB (3a)

Separation of Copper from Complex Cu-Pb-Sn-Sb Alloys. *Tzvetnuie Metallui,* Jan. 1933, pages 99-100. (In Russian) Laboratory experiments showed that Cu can be removed almost completely from complex Cu-Pb-Sb-Sn alloys by melting with large amounts of PbO. BND (3a)

Improved Die Steels Key to Greater Economies in Die Casting. A. H. Allen. *Steel,* Vol. 94, Feb. 19, 1934, pages 23-25. Precision Casting Co., Inc., producers of Zn and Al die castings, has improved its die technique to the point where dies for Al castings will stand up successfully for 250,000 shots, all conditions being favorable. For Zn castings, low-Cr steel dies with 0.40% C are used. They are heated to 1600°-1625°F., quenched, and drawn at 1050°-1100°F., resulting in a Brinell hardness of 380-400. Typical die steel for Al castings is a Co-Cr-W steel with 0.45% C. It is heated to 1825°-1850°F., quenched or allowed to cool in air, and drawn at 1100°-1150°F., resulting in a Brinell hardness of 400-425. Certain dies are plated with a thickness of 0.004-0.005 in. Cr. One of the largest dies made weighs 9,000 lbs. and is used for casting 16-lb. Al crank cases. MS (3a)

Die Castings. A. H. Allen. *Steel,* Vol. 93, Nov. 20, 1933, pages 23-25. Describes equipment and practice of the Doehler Die Casting Co., Toledo, O. Company designs and builds its casting-machines. Latest design for casting Zn is an automatic-type, known as an angular, power-back, mechanical-stroke machine, which requires the operator only to remove the casting from the dies. Al casting-machines are of the air-back and power-back types with a gooseneck connection from the melting-pot to the dies. Temperature of molten metal in reservoirs is regulated by separate automatic temperature control instruments connected to each machine. Metals are melted before being supplied to the casting-machines, Al being melted in a rotating cylindrical, end-fired furnace, and Zn, in a stationary pot-type furnace. With Zn castings, about 200,000 shots can be obtained from a single die, while with Al castings, this number ranges up to 100,000. MS (3a)

White-metal Lining Bearing Shells Centrifugally. L. Francis Ayland. *Machinery,* London, Vol. 43, Dec. 7, 1933, page 279. Deals with the operation of white metal lining bearing shells in complete halves (without shims) and the fixture involved. Kz (3a)

Running Quality of Molten Metals. Its Application to Study of Iron-Carbon Alloys. A. I. Krynitsky. *Metals & Alloys,* Vol. 4, Nov. 1933, page 176. An extended abstract of an article by M. Rene Berger. *Association Technique de Fonderie de Belgique,* No. 17, Aug. 1932. Technique of measuring the running quality of molten metal by the length run in a spiral mold made from specially designed pattern is described and data shows results on Fe-C alloys for various C content 2.00%-4.50% and 50° to 300°C. superheat above the liquidus. Effect of size of core filters on length of spiral is discussed. WLC (3a)

The Electrolysis of Metals, Studied with a Scraped Electrode. J. Koekstra. *Collection of Czechoslovak Chemical Communications,* Vol. 6, Jan.-Feb. 1934, pages 17-36. (In English) The results of Heyrovsky, obtained with reductions on dropping mercury, made it seem advantageous to make use of the principle of a continuously renewed surface also on non-liquid electrodes. For this purpose a mechanically scraped electrode was prepared which is described in detail and the electrolyses of Ag, Hg, Cu, Pb, Fn and Ni have been studied together with microscopical observations. Preliminary experiments in 1N $AgNO_3$ unscraped electrodes, showed that the current voltage curve shows a distinct irregularity on the cathodic end. The occurrence of such irregularities in the deposition of silver from $AgNO_3$ solutions has been found that were not due to impurities. Using a scraped electrode the current voltage curve is a straight line. Velocity of scraping influences but little the shape of the curves. Changes in the pressure of the scraper also have only negligible influence. Using a non-scraped electrode the curves show a horizontal part. The length of this part of the curve is smaller in an atmosphere of H_2 than in N_2 or CO_2 atmospheres: the last-named gases, therefore, cause deactivation. In electrolysis of Hg, a solution of $HgNO_3 + HNO_3$ was electrolyzed between mercury drops of known size. The polarogram again was almost straight line. In electrolysis of Cu, this metal is shown to be very dependent upon previous polarization. It was found that the change in equilibrium potential by cathodic polarization represents a lowering effect, because the original condition is not immediately reproduced by filing off the electrode surface. Although Cu behaved like Ag, here no reproducible polarograms could be obtained. Scraping has hardly any influence upon lead; the curves for normal electrolysis are already almost straight. However, without scraping they show little irregulatities which vanish upon scraping. In electrolysis of Zn the influence of scraping is very large. The electrolysis of Ni with a scraped electrode is fundamentally different from the electrolyses mentioned so far. The polarization at a current-density of 1 MA/cm^2 is diminished by about 150 M.V. by scraping, but the curve obtained does not become straight. Microscopic observation of the metallic deposits revealed for Ag a number of lines on the surface which indicates that the newly formed metal spreads out in thin layers over the crystals already formed. With Cu the lines can also be seen (500 magnifications) but very indistinctly; they move extremely slowly (0.0001 cm. in 5 minutes). With Pb the lines are very pronounced, these lines are at first regularly flowing behind each other but after a short interruption of the electrolysis grow quite irregularly in the first moment. By a sudden increase of the electrolytic potential very fine needles of lead could be produced, which grew exceedingly fast in the direction of the axes of the main crystal. With Sn the lines are also quite plain but the tin crystals dissolve partially again after interruption of the current. With Tl the spontaneous dissolution was still more pronounced. With Fe, Ni and Co finally no lines could be observed. GTM (3a)

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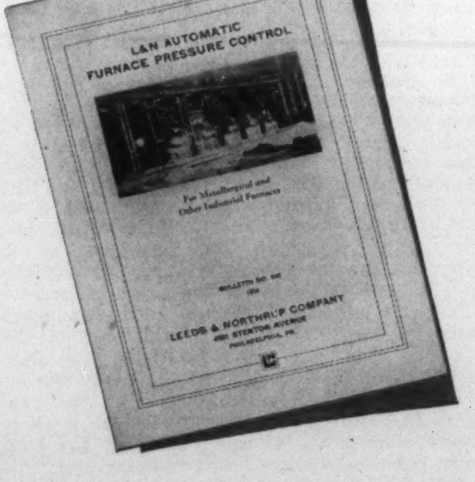

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Ferrous (3b)

C. H. HERTY, SECTION EDITOR

Vacuum Induction Crucible Furnace (Vakuum-Induktions-Tiegelofen) H. Wentrup. *Zeitschrift Verein deutscher Ingenieure,* Vol. 78, Jan. 13, 1934, pages 58-59. Present drawbacks of vacuum furnaces for the production of high-quality steels are reviewed and a recent construction described of a crucible for 10 kg. steel in which the material is deoxidized to a very great extent already by C alone, without the usual addition of Mn, Si, or Al so that inclusions of deoxidation products are eliminated. Also the content of gas in the melt is reduced on account of its motion, only 5.3 cm.^{3} per 100 g. melt by actual measurement. Ha (3b)

Fluorspar. A. Wilson. *Sands, Clays & Minerals,* Vol. 1, July 1933, pages 6-10. The fluorspar as used in the steel industry is said to perform the following functions: it lowers the melting poing of the slag, thus allowing lower furnace temperature and increased operating speed; it increases the fluidity of the slag, permitting the escape of gases from the metal and making the slag easier to handle; it aids in the removal of S and P by volatilization and by slagging either by direct action or by enabling a more highly basic slag to be produced. As fluorspar is seldom found in pure state it must be concentrated and the positively harmful constituents galena, blende and barytes carefully removed. American standards prescribe at least 85% CaF_2 with a maximum of 5% SiO_2. German products average 90% CaF_2 with the silica removed. Statistics on deposits, world production and prices, and consumption in different industries are given. Ha (3b)

Properties of Gray Cast Iron as Affected by Casting Conditions. C. M. Saeger, Jr. & E. J. Ash. *Transactions & Bulletin, American Foundrymen's Association,* Vol. 5, Feb. 1934, pages 449-468. A preliminary report of an investigation to determine the effect of maximum heating temperatures on the physical properties of different types of cast iron is given in this paper. A typical stove-plate iron, a mixture of this plate iron with 20% of commercial open-hearth ingot iron and a high-C, low-Si, low-P pig iron were used. Duplicate cylindrical transverse test bars 23″ in length and 2.2″, 1.2″, 1.5″, and 0.75″ in diam. were cast from each heat in one "bottom poured" dry sand mold. The irons were melted in a high frequency induction furnace. Maximum heating temperatures used were 1400°, 1500°, 1600°, and 1700° C. Samples for determination of shrinkage were taken and spirals for determining the running qualities of the metal were poured. Transverse breaking load, deflection, modulus of rupture and elasticity, hardness, density and microstructure were studied. The transverse breaking strength for each iron changed with maximum temperature to which the iron had been heated. In general, the density of the solid metal and linear contraction increased with heating temperature of the metal. The running quality of the irons investigated was apparently not affected by the maximum heating temperature. Microstructure of 1.2″ bars indicated that irons of highest strength had relatively small graphite flakes and pearlitic-sorbitic matrix. CEJ (3b)

Steel Making in the Basic Converter, Thomas Slag (Fabrication de l'acier au convertisseur basique, scorie Thomas) Marcel Laffargue. Ch. Beranger, Paris, 1933. Paper, 5½x9 inches, 158 pages. Price 35 Fr. Current French practice with the basic converter on high P iron is described and the rate of oxidation of the elements shown in curves. Starting with iron of 3.5% C, 1.80% P, 1.15% Mn, 0.40% Si, 0.06% S, it is blown to 0.04% C, 0.05% P, 0.25% Mn, 0.0% Si, 0.03% S and picks up about 0.015% N. Ferromanganese is added to bring it to 0.45% Mn, 0.06% C.

It is stated that instead of Mn, deoxidation can be effected by Al, Na or Ti. Ti corrects the aging effect due to nitrogen. Laffargue says, "Twice as much Al as Mn is required to arrive at the same degree of deoxidation. Under these conditions, the steel contains 0.60% metallic Al and many alumina inclusions. It cannot be rolled."

In making the higher carbon grades of steel, the Mn should be increased along with the C to avoid cracking in rolling. For medium carbons, spiegel is therefore a suitable recarburizer, but must be added molten.

Kinks in the blowing of the charge are described. Ingot molds, rimming, killing and rolling the steel are briefly discussed. Lime for slagging, the lining of converters and ladles, and the production of slag suitable for fertilizer are also briefly dealt with. There is an index. The paper is poor.

As a concise description of a type of steel making practice not used in this country, the pamphlet is of interest. H. W. Gillett (3b)-**B**-

A Manual of Foundry Practice. J. Laing & R. T. Rolfe. Chapman & Hall, London, 1934. Cloth, 5¾x8¾ inches, 276 pages. Price 15s. Elementary text book on molding (sand and loam), core making, gating, the metallurgy of cast iron, cupola melting, with very brief mention of the effects of Ni and Cr, and still briefer discussion of pearlitic irons. Fourteen pages are devoted to a sketchy account of non-ferrous founding. A few generalities on sand testing and the testing of cast iron are included.

The book is a concise introduction to cast iron foundry practice but does not dip very deeply into metallurgy. H. W. Gillett (3b)-**B**-

Cupola Furnaces and Recent Constructions (Il Cubilotto nella Stampa technica e nelle recenti Costruzioni) M. Barigozzi. *L'Industria Meccanica,* Vol. 16, Jan. 1934, pages 28-36. The performance of a cupola furnace, the melting process, its efficiency as dependent on blast velocity and temperature, arrangement of tuyeres, preheated air and constructive details are reviewed. The various theories of efficient ore reduction, melting times and amount of coke needed are discussed. Ha (3b)

Making the Mold of a Bowl-Shaped Stand According to 2 Different Methods (Die Herstellung der Form zu einem schalenförmigen Untersatz in zweierlei Ausführungen) Arno. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Feb. 18, 1934, pages 81-83. Discusses 2 different molding procedures in making part in question. Part is made by sweep molding. According to one method loam core is required, in second cheaper method core can be dispensed with. GN(3b)

Comparisons of Different Pig Iron—Ore Practices (Vergleichende Gegenüberstellung verschiedener Roheisen-Erz-Verfahren) W. Alberts. *Stahl und Eisen,* Vol. 53, Nov. 16, 1933, pages 1173-1184. Casts are given for open-hearth operation with different combinations of pig iron, ore, and scrap; 100-300-ton tilting furnaces are considered most adaptable in this respect. SE (3b)

Irons and Armatures in Sand Molds (Crochets et Armatures) M. Dozo. *La Fonderie Belge,* Vol. 3, Aug. 1933, pages 114-118. When a part of rammed sand projects out of a flask which has to be lifted for stripping the pattern, it is of common practice to hold projecting part by means of hooks. Particulars are given concerning these hooks and their uses: Hooks are preferably of round section which allows better escape of gases in sand between casting and hooks. Cast Fe hooks are sometimes used, their disadvantages are: (1) their manufacture is more expensive than that of steel ones which are obtained through bending the two ends of a piece of rolled wire. (2) Molten cast Fe is not cheaper than rolled steel. (3) More cast Fe hooks are needed for a given work because they break easily during ramming and shaking out. (4) Cast Fe hooks are heavier than steel ones because they require larger section for same strength. (5) When not correctly poured, cast Fe hooks may have fins which are very dangerous for workers. (6) They have a square section. Advantages of cast Fe hooks are: (1) they can be easily broken at desired lengths. (2) Having a greater section than steel ones they are more rigid. In a mold, hooks must be set vertically and pressed against bars of flasks, number of hooks must be not excessive in order not to increase unduly weight of mold and disturb free escape of gases during pouring. FR (3b)

Studies on Solidification and Contraction and Their Relation to the Formation of Hot Tears in Steel Castings. Charles W. Briggs & Roy A. Gezelius. *Transactions & Bulletin, American Foundrymen's Association,* Vol. 5, Feb. 1934, pages 385-448; *Foundry Trade Journal,* Vol. 49, Sept. 21, 1933, pages 157-160; Sept. 28, 1933, pages 173-174; Oct. 5, 1933, pages 193-195. Solidification of castings, involving the principle of equal cooling is undesirable. The more natural method of directional solidification can be successful only when the principles stressing the importance of feeding smaller sections through heavier ones and by studying mass effect by the use of inscribed circles are adopted. Mold resistance is responsible in the major part for the existence of hot-tear cracks in steel castings. Pipes or cracks producing centers of stress concentration are factors in the formation of hot-tears. Physical properties such as strength at solidification temperatures and fluidity are also factors. Internal hot-tears develop during the solidification of the casting and are caused by a lack of controlled directional solidification. External hot-tears develop after solidification is complete and is due to mold resistance. Hot-tears may be limited by any of several methods. OWE+CEJ (3b)

Gray Iron Production in the Direct Arc Acid-lined Electric Furnace. Clyde L. Frear. *Transactions & Bulletin, American Foundrymen's Association,* Vol. 4, Dec. 1933, pages 289-313; *Journal du Four Electrique,* Vol. 43, Jan. 1933, page 23. A method of melting gray cast iron in the direct-arc acid-lined electric furnace is described. Points to be stressed in the furnace operation are (1) Correct building up and ramming of the hearth and repairing of the same (2) Elimination of silica from the slag in the surface of the bath (3) Melting in such a manner as to have the C content of the molten bath very close to the desired value (4) Control of graphite nuclei in the molten bath to produce the strength, machinability and other properties desired. JDG + CEJ (3b)

Piston Ring Production. J. S. Irving. *Automobile Engineer,* Vol. 23, Sept. 1933, pages 335-336; Oct. 1933, pages 385-387. Centrifugal castings are suitable for piston rings due to the extreme closeness and fineness of the grain. Material requirements of automobile piston rings are covered by the British Standards Institute specification 5004, and the Air Board specification 4K6. Chemical requirements are the same in both specifications. Total C 3.50% maximum, combined C 0.45% to 0.80%, Si 1.80% to 2.50%, Mn 0.40% to 1.20%, S 0.12% maximum, and P 1.00% maximum. The part published in Oct. deals with tempering. Several references are given in the footnotes. Oil quenching from 830° C. gives a great increase in hardness but the tensile strength is reduced to about 70% of its original value. Maximum strength value is obtained by tempering between 300°C. and 350°C. Brinell hardness is reduced somewhat by tempering but still remains over 500 Brinell. Photomicrographs show structure of both hardened and unhardened piston ring cast iron. Results obtained in service indicate that hardened and tempered piston rings greatly reduce cylinder wear especially if used with hardened and tempered liners. RHP (3b)

Cupola Furnaces and Casting (Les Cubilots et la Coulée) Itam. *Revue de Fonderie Moderne,* Vol. 28, Jan. 19, 1934, pages 1-5. Previous results of influence of size of tuyeres on the melting process (see *Fonderie Moderne,* Nov. 10, 1933) are discussed; after more recent tests it has been confirmed that maximum temperatures can be obtained in a cupola furnace equipped with properly arranged small tuyeres without having to resort to recuperating systems as before. Ha (3b)

Dependence of Equilibrium $FeO + Ni \rightleftarrows NiO + Fe$ in the Melt of SiO_2 III. Report on Equilibria between Metals, Sulphides and Silicates in Molten State (Die Abhängigkeit des Gleichgewichts $FeO + Ni \rightleftarrows NiO + Fe$ im Schmelzfluss von SiO_2-Zusatz. III. Mitteilung über Gleichgewichte zwischen Metallen, Sulfiden und Silikaten im Schmelzfluss) W. Jander & Hans Senf. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 217, Feb. 23, 1934, pages 48-52. This preliminary report deals with the silicates which SiO_2 can form with FeO and NiO in molten state. The change of equilibrium with increasing SiO_2 contact shows a decrease of the equilibrium constant up to 12% SiO_2, beyond this value it remains constant. The change of the equilibrium constant with temperature is fairly great and is given by $\log K_H = -6300/T + 1.29$. Ha (3b)

Influence of Phosphorus on Castability of Iron-Carbon Alloys (Influence du Phosphore sur la Coulabilité des Alliages Fer-Carbone) R. Berger. *La Fonderie Belge,* Vol. 2, Jan. 1933, pages 14-21. Present studies intend to determine in which sense phosphorus modifies curves showing variation of castability in relation to C contents, tests being made at a constant temperature. Tests have only dealt with cast-Fe with C contents ranging from 2.5 to 4.5%. Conclusions of present studies can be summarized as follows: (1) Influence of P when C is kept constant: At constant temperature, castability increases with increasing P contents and then decreases. The lower the C content the higher the P content at which maximum castability is obtained. With increasing P contents, castability increases first slightly and then rapidly. The lower the C content the higher the P content at which elbow of the curve is noted. It is concluded that castability increases up to P content at which eutectic corresponding to considered C content is formed. (2) Influence of C when P is kept constant: Within hypo-eutectic range, castability increases with increasing C content. Castability maximum moves towards low C contents when P increases. The higher the P content, the slower this castability change which disappears completely for P content as high as 3%. Within hyper-eutectic range, castability decreases with decreasing P content. For C contents higher than 4%, castability change is low. (3) A study of castability curve built over the ternary Fe-C-P diagram shows that displacement of castability maxima with P variation is not in accordance with Spencer's Theory which imputes castability increase to lowering of liquidus temperature. FR (3b)

Is a High Share of Scrap in Charge Economic? (Ist hoher Bruchzusatz wirtschaftlich?) R. Stotz. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Feb. 4, 1934, pages 51-52. C. Rein. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Feb. 18, 1934, pages 70-72. Controversies between Stotz and Rein on Rein's former paper in *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Oct. 1, 1933, pages 401-402. Data presented by Stotz are to prove that high share of scrap in charge is economic. Rein's assumption that oxidation loss increases with increasing share of scrap is refuted on base of assumption that this figure fluctuates considerably and cannot be determined accurately. In his reply Rein doubts accuracy of data given by Stotz and points out that Stotz misinterpreted Rein's former statement on poor economy of cupola melting in using high share of scrap in charge. GN (3b)

On the Role of Lime in the Desulphurization of Iron and Steel (Ueber die Rolle des Kalkes bei der Entschwefelung von Eisen und Stahl) I. Trifonow & D. Mirew. *Archiv für das Eisenhüttenwesen,* Vol. 7, Dec. 1933, pages 337-341. The reactions between 2 CaO + FeS, 3 CaO + FeS, and CaS + FeO were studied over blast furnace and open hearth temperature ranges. At temperatures above about 1000° C., the quantity of CaO present is the determining factor in desulphurization, i. e., the amount of CaS formed in place of FeS. Thus in a mixture of CaS : 2 FeO the S goes completely to FeS, whereas in a mixture of 2 CaO : FeS, the S goes to CaS. The presence of FeO opposes the formation of CaS because it reduces the proportion of CaO by combining with it to form CaO · FeO. Deoxidizers like Al, Mn, Mg, Si, and C aid desulphurization by reducing the amount of FeO. SE (3b)

Manufacture of Machine Stands by Coreless Molding on Shaker Machines (Die Herstellung von Maschinengestellen durch kernloses Formen auf Rüttelmaschinen) Carl Wagner. *Die Giesserei,* Vol. 21, Feb. 2, 1934, pages 49-51. An example illustrates a method of molding a complicated pattern without core by rately formed by hand thus saving costs against molding it as a whole with cores. splitting it into several parts which are connected by dowelpins and can be sepa- Ha (3b)

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Casting of Piano Frames (Das Giessen von Klavierrahmen) W. Mueller-Paersch. *Die Giesserei,* Vol. 21, Mar. 2, 1934, pages 96-97. Cast iron for a good piano frame has approximately the composition: 3.3% C, 0.5-0.65% Mn, 2.5-2.8% Si, 1.4-1.6% P and maximum 0.07% S; the furnace should produce a rapidly melting and very hot Fe as this makes sure that all gases in the mold can escape through the liquid Fe. The particular requirements for molding and for the iron pattern are described; the pattern must not have any sudden changes in thickness; the frame should cool in the mold to 150° C. before it is taken out. Ha (3b)

Content of Sulphur of Cast Iron as Function of Duration of Melting of the Cupola Furnace (Der Schwefelgehalt des Gusseisens in Abhängigkeit von der Schmelzdauer der Kupolofens) A. Nehmitz. *Die Giesserei,* Vol. 21, Jan. 19, 1934, page 31. The view that the first iron after tapping is richer in S than later melts was checked by some tests. It seems that at first the S content decreases about 5%, but after 45 min. the original value is reached again and slowly reaches a maximum. At the end of the melting period a slight reduction seems again to occur. It is suggested to study these conditions more systematically. Ha (3b)

Calculation of Airblast for Cupola Furnaces from the Analysis of the Waste Gases (Die Berechnung der Windmenge bei Kupolöfen aus der Abgasanalyse) H. Jungbluth & P. A. Heller. *Technische Mitteilungen Krupp,* No. 4, Dec. 1933, pages 105-111. Formulas are derived which are required for the calculation and evaluation of data of the metallurgical processes in the cupola furnace. From these formulas nomograms are developed by which the numerical relations between CO_2 and CO of the flue gas, and between analysis of the gas, coke charge, melting capacity and amount of airblast can be read directly. Two slide rules were made on the basis of the formulas for calculating airblast and CO_2 content of the lime. Ha (3b)

Desulphurizing Iron with Beryllium (Über die Entschwefelung von Eisen mit Beryllium) W. Kroll. *Metallwirtschaft,* Vol. 13, Jan. 12, 1934, pages 21-23. When Be is added to iron or steel containing high percentages of S it combines with all of the S. If the S content is high enough BeS separates as a layer on top of the metal, but not at the grain boundaries. Steel containing as high as .4% S when treated with sufficient Be can be rolled into sheet and is not red short. In high C steels an excess of Be over that required to combine with the S has a slight influence on its ability to be hardened. Be is also useful as a desulphurizer for Ni, which can be rolled without the addition of Mg. Be is a more powerful deoxidizer than Al and Mn. CEM (3b)

Silicon and Manganese as Deoxidizers in Cast Iron. A. H. Dierker. *Transactions & Bulletin, American Foundrymen's Association,* Vol. 5, Feb. 1934, pages 469-480. A marked change in physical properties was secured by making increasing additions of small amounts of Mn to a gray cast iron low in that element. Brinell hardness dropped on the first addition and then gradually increased on further additions. The first Mn addition changes the original pearlitic structure to ferritic which with further additions gradually returns to the pearlitic structure. The principal deoxidizing elements in the cast iron are C, Mn and Si. A theory is suggested to account for the changes in the cast iron. CEJ (3b)

Reactions between Pig Irons and Their Slags (Ueber die Reaktionen zwischen technischen Roheisensorten und ihren Schlacken) W. Dinkler. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Düsseldorf, Vol. 15, No. 15, pages 187-195. In order to be able to get an insight into the reactions on the hearth of the blast-furnace samples were taken of the tapped slag and of the slag of the running material, melted again, and the reactions between them studied with respect to duration and temperature of the reaction and basicity of the slags. 60 to 80% of the FeO content (ferrous oxide) of the slag are reduced almost immediately, then reductions of Mn and Si commence but go on much more slowly; both these reductions increase with length of time and temperature. This proves that, contrary to general opinion, Mn and Si can not be reduced on the hearth as normal blast-furnace slags contain considerable amounts of FeO. If the slag is acid much SiO_2 and no MnO is reduced; the conditions are reversed for basic slag. The inversion point from acid to basic character was determined at a basicity degree of 54-56. A comparison of the equilibrium constants of these experimental melts with previous measurements of the equilibrium constants of the Mn reaction shows approximately the same figures for Thomas pig iron with low Si content, while for higher Si content of the Fe and low FeO content of the slag lower K_{Mn} values were obtained. The individual tests are given in full. 5 references. Ha (3b)

Molding and Casting of a Hydrant Set (Formen und Giessen einer Hydrantengarnitur) A. Freitag. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Jan. 21, 1934, pages 27-30. Detailed discussion of molding and casting procedure under following headings (1) flask for hydrant body, (2) pattern making of hydrant body, (3) core making of hydrant body, (4) molding of hydrant body and attached pipe connection, (5) processing of flange pipe, 1500 mm. in length, 8 mm. thick, (6) making of pipe bend. GN (3b)

Non-Metallic Impurities in Steel Castings (Impuretés non-métalliques dans les Moulages d'Acier) F. Giolitti. *L'Usine,* Vol. 42, Mar. 24, 1933, pages 25-27. See *Metals & Alloys,* Vol. 5, Mar. 1934, page MA 105. Ha (3b)

Determination of Oxygen in Alloy Steels and Its Effect upon Tube Piercing. Newell Hamilton. *Metals Technology, American Institute Mining & Metallurgical Engineers, Technical Publication* No. 540, Feb. 1934, 12 pages. During the past 6 years steel from some heats of 18-8 type material was found to check badly on the surface during piercing. Analysis of the defective material indicated that it differed from satisfactory material only in that it contained more O. A vacuum-fusion apparatus, described in some detail, was constructed and the O and H content of many steels of the 18-8 type determined. The apparatus was a modification of that developed at the Bureau of Standards. Work indicated that fusion temperatures between 1700 and 1725°C. gave repeatable results. The data obtained proved that steel of a high O content usually developed surface cracks on piercing. The average O content of steel that did not crack was 0.0066% and that of steel with surface cracks 0.018%. No correlation between H or N content and behavior during piercing could be found. If the O of the steel was "fixed" by adding Al or Zr to the ladle surface defects did not occur but the tubes contained splits and tears. The steels were made by the basic-electric process in 6- or 12-ton heats. High O in steel containing 5% Cr and 0.5% Mo also caused surface defects on piercing. JLG (3b)

Continental Developments in Open Hearth Steel Making (Nagra data fran martinprocessens utveckling pa kontinenten) G. Helmer. *Jernkontorets Annaler,* Vol. 118, Jan. 1934, pages 22-36. Furnace design, heat resistant materials, gas making, furnace economies, charging and discharging, repairs, special processes, and builders' specifications are the subjects discussed. HCD (3b)

Manufacture of a Large Pulley of 6000 mm. Diameter with Smallest Costs Considering Operating Conditions (Die Herstellung einer grossen Riemenscheibe von 6000 mm. Durchmesser, unter Berücksichtigung der Betriebsverhaltnisse, mit geringstem Kostenaufwand) H. Hertlein. *Die Giesserei,* Vol. 21, Jan. 19, 1934, pages 27-29. Describes in full procedure under very primitive conditions. Ha (3b)

Pattern Plate for Handbarrow Wheels of Cast Steel (Modellplatte für Stahlguss-Schiebkarrenräder) Hugo Hollweg. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Feb. 18, 1934, pages 67-70. Author discusses arrangement of pattern plate for molding on turnover type molding machine handbarrow wheels 400 mm. in diameter. Described in detail are various parts of bottom flask pattern plate, top half pattern plate, centering method of both pattern plate halves. GN (3b)

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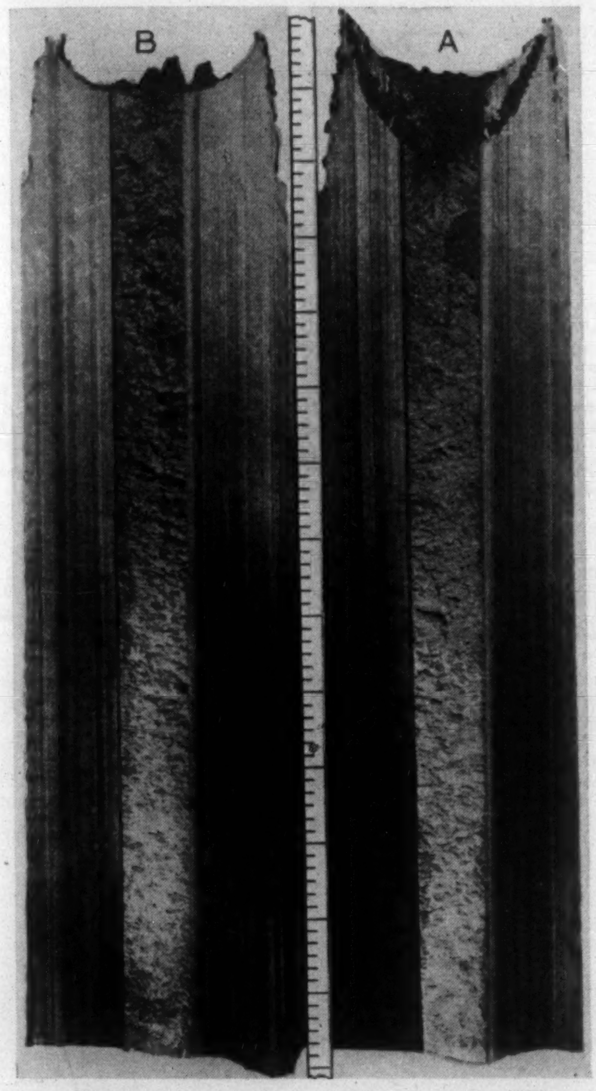

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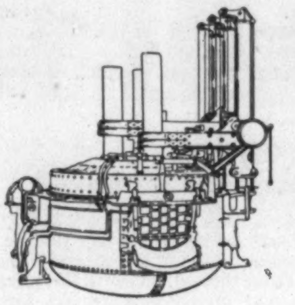

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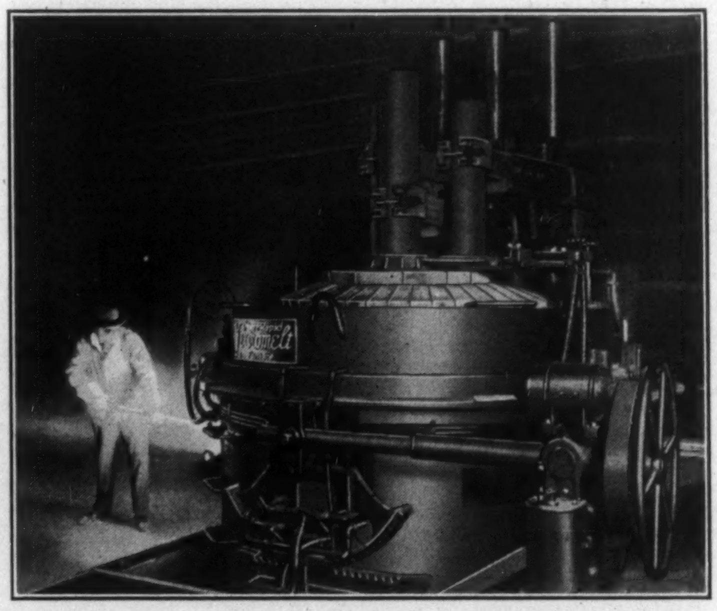

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WORKING OF METALS & ALLOYS (4)

Working in Stainless Steels. F. Leverick. *Iron & Steel Industry & British Foundryman,* Vol. 6, Mar. 1933, pages 215-218. Reference is made to heat-treatment and annealing, machining, soldering and brazing, welding, gas cutting, forging, pickling, grinding and polishing, and deep pressing of (A) soft steels containing 14% Cr, 0.1% C or less, (B) steel with 17% Cr and about 0.30% C and (C) the 18-8 stainless variety. CHL (4)

Highly Developed Production Equipment Made Available in 1932. Ralph E. Miller. *Iron Age,* Vol. 131, Jan. 5, 1933, pages 50-53. Describes new equipment introduced during 1932 for machining, stamping, forging, welding and other metal working operations. VSP (4)

Rolling (4a)

RICHARD RIMBACH, SECTION EDITOR

Preheats Sheet Rolls Electrically. *Iron Age,* Vol. 131, May 18, 1933, page 782, adv. sec. page 14. Describes method developed by the Electric Furnace Co., Ltd., London, England, for preheating rolls of sheet and tin plate mills by means of electrical induction. Rolls to be heated, mounted in place, are encircled by Cu strip or bar wound on edge and brazed together and supported on 2 rods. Heater is supported clear of rolls so mill can be revolved. The heater is worked from a 100 to 120-volt single phase supply. Cost of operation of heater is very low. Induction heater may be used in annealing of green rolls before they are put into service. This method of heating develops heat gradually in mass of metal between surface and core, and therefore excessive internal strains are not likely to occur. Includes a table giving breakage of rolls without preheating and induction heated. VSP (4a)

Latest Development of Seamless Steel Tube Rolling Process (Die neueste Entwicklung des Nahtlos-Stahlrohrwalzverfahrens) H. Reupke. *Die Metallbörse,* Vol. 23, Dec. 23, 1933, page 1634; Vol. 24, Jan. 6, 1934, page 19. Low C and Ni-Cr steel are utilized for making seamless steel tubing of 30-1500 mm. diam. and a minimum wall of 3 mm. These tubes are submitted to cold drawing to produce any reasonable gage down to needle-like tubes. Due to pickling, drying, lubricating and annealing procedures involved, these tubes are always more expensive than the corresponding welded size. One did not succeed in combining the 2 working operations involved in seamless tube manufacture. A new design provides for 16 rolls instead of the former 2. Experiences gained on this rolling mill are also incorporated in the new "Streckschrägwalzwerk" whose housing is only 44 cm. high with reference to a 60 mm. tube. The minimum wall size could be reduced from 2.75 mm. to 1.9 mm. The novel Roeckner seamless tube mill is patterned after the forging process. Several sets of roll pairs are employed. The stretching takes place principally perpendicular to the direction of rolling. The American contribution of S. & A. Driescher is considered. EF (4a)

Effect of Friction in Rolling Strip Steel. W. Lueg & E. Osenberg. *Blast Furnace & Steel Plant,* Vol. 22, Jan. 1934, page 48; Feb. 1934, page 122. See "The Influence of Friction in Rolling Steel Strip," *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 129. MS (4a)

Progress in Lubrication of Rolling Mills (Les Progrès Réalisés dans le Graissage des Laminoirs) Paul Martinet. *La Technique Moderne,* Vol. 25, Sept. 1933, pages 574-579. Working conditions of mills are studied and lubricating devices for roll ends are reviewed. In last section lubrication of gear boxes, in order to reduce wear is discussed. FR (4a)

Rolling Mill Practice. Pt. I. Donald W. Lloyd. *Blast Furnace & Steel Plant,* Vol. 22, Jan. 1934, pages 31-33, 56. High cost of continuous blooming-mills is the principal objection to their use. If they were used the time lost manipulating and reversing on the customary 2-high reversing or 3-high mills, could be used for rolling and the speed of the rolls reduced considerably. With slow-speed rolling the force from the rolls penetrates to the center of the bloom, resulting in solid steel throughout. Heavier drafts can be used and fewer passes will be required. Less power is needed than with the old types of mills. Quality of steel will be improved as rolls will not need ragging, which causes slivers. Includes table giving necessary speeds in r.p.m. of a continuous bloomer. MS (4a)

Cold Rolling Processes. Lloyd Jones. *Sheet Metal Industries,* Vol. 7, Sept. 1933, pages 267-271; Oct. 1933, pages 339-341; Nov. 1933, page 401. The article opens with a discussion of a new mill using laminated housings made of steel forgings. The most important elements which affect gage in rolling are roll contour and the accumulation of heat in the rolls. The effect of temperature change on roll contour, and a method of automatic temperature control are discussed rather thoroughly. AWM (4a)

Is the Use of Roller Bearings in Heavy Hot Rolls Economical? (Ist die Verwendung von Rollenlagern in schweren Warmwalzwerken wirtschaftlich?) E. Howahr. *Stahl und Eisen,* Vol. 53, Dec. 14, 1933, pages 1293-1301. A detailed discussion of the advantages of various types of roller bearings and of practical roller bearing installations and their lubrication. SE (4a)

Inland Steel Tin Plate Mill. *Blast Furnace & Steel Plant,* Vol. 22, Feb. 1934, pages 93-95. **Chicago Steelmaker Operates New Tin Mill Equipment.** *Steel.* Vol. 94, Feb. 12, 1934, pages 26-27. Brief, illustrated description of mill at Indiana Harbor, Ind. An exceptionally heavy 5-stand tandem cold mill produces black plate from hot-rolled strip. It is capable of rolling material 36 in. wide to 38 gage at a maximum delivery speed of 700 ft./min. There is also a 38-in. Steckel mill for rolling light-weight material. Annealed strip is finished on heavy, 4-high type skin rolling-mills. MS (4a)

Overhead Line Conductors. *Electrical Review,* Vol. 114, Feb. 9, 1934, page 189. Describes rolling of wire rods at the works of Templeborough Rolling Mills, Ltd., Rotherham, Eng. Rolling-mill itself is a double-stranding Morgan continuous mill with 17 pairs of rolls and has an S-shaped lay-out. MS (4a)

Remodeled Tata Sheet Mills Triple Production. *Iron Age,* Vol. 131, May 11, 1933, pages 745, 758. Describes the remodeled sheet mill of the Tata Iron and Steel Co., Ltd., at Jamshedpur, India. VSP (4a)

Three Types of Mills Compete for Flat Rolled Tonnage. *Steel,* Vol. 94, Jan. 1, 1934, pages 122-123. Reviews developments and activities in rolling-mill industry during 1933. Among these are mechanically equipped cold-mills for strip and tin-plate; paints and finishes suitable for sheets of ordinary surface finish; continuous gaging of strip during reduction; instrument for indicating % of reduction; 3-high mills; composition bearings; and miscellaneous auxiliary equipment. MS (4a)

Forging & Extruding (4b)

A. W. DEMMLER, SECTION EDITOR

Contribution to the Study of Forging (Contribution à l'Etude du Forgeage) Bréhamet. *Arts-et-Métiers,* Vol. 85, Jan. 1933, pages 4-12. Study aims at determining, according to sketch of piece to be forged and available tools and dies, pressure necessary for forging operation. Method of computation is given for carbon and alloy steels forged at about 1050°C. but could be applied, with other figures, to any other forgeable alloy. Resistance offered by metal to crushing is determined. It is shown that for final thickness over 40 mm. resistance is about constant at 4 kg./mm.^{2} but that for thicknesses smaller than 6 mm. resistance becomes considerable. Examples of application of proposed method are given for hot pressing and drop forging. With press drawing, pressure actually measured is in close agreement with that given by computation proving usefulness of proposed method. FR (4b)

Horizontal Forging Machines (Waagerechte Schmiedemaschinen) G. Wollenweber. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, Mar. 4, 1933, pages 244-248. The general principles of machine forging are discussed and the particular suitability of a horizontal forging process, due to the possibility of production of pieces of very high quality and great accuracy, explained. Full details of construction of several forging presses are described. Ha (4b)

Making Drawing and Forging Dies from Gray Cast Iron. F. B. Coyle. *Steel,* Vol. 92, June 19, 1933, pages 26-27. Part of a paper on industrial applications of heat-treated gray cast-Fe presented before the New York Chapter, American Society for Steel Treating. MS (4b)

Forging Temperatures of Steel. J. H. G. Monypenny. *Heat Treating & Forging,* Vol. 19, Oct. 1933, pages 38-39, 44; Nov. 1933, pages 70-72. See "Forging & Rolling Temperatures of Steels," *Metals & Alloys,* Vol. 5, Jan. 1934, page MA 22. MS (4b)

Forming Aluminum and Brass Products by the Extrusion Process. J. B. Nealey. *Machinery,* N. Y., Vol. 40, Nov. 1933, pages 140-142. Methods and equipment used in producing extruded shapes by forcing the material through a die under high pressure are explained. Ha (4b)

Compressed Air Hammer (Pilon Pneumatique) Jaussaud. *Arts-et-Métiers,* Vol. 85, Apr. 1933, pages 139-141. Description of a hammer suitable for jobbing forge shops is given. This hammer is set in motion by an electrical motor giving compressed air. Computations for designing this hammer are explained. FR (4b)

Hot-Pressing of Intricate Brass and Bronze Parts. *Machinery,* N. Y., Vol. 40, Sept. 1933, pages 29-30. Describes operation of hot-pressing process and manufacture of smooth and accurate parts from billets. Ha (4b)

Stress of Times Centers Progress in Forging Industry in Die Design. *Steel,* Vol. 94, Jan. 1, 1934, page 123. Reviews developments in the forging industry in 1933. Chief progress was in further use of extrusion forging; Cr plating of dies to increase their life; more general application of die typing; and combination of forging and stamping operations. MS (4b)

Making Concentric Sections by Roll-Forge Process. *Steel,* Vol. 93, Nov. 20, 1933, page 26. F. W. Trabold has developed a process and machine for production of round steel parts, concentric throughout their axial length. In this machine, heated stock is reduced and formed as it passes between 2 formed rolls and at the same time is rolled in a transverse direction. Top and bottom rolls are identical. As the upper roll moves to the right, the lower one moves to the left. This oscillating action operates simultaneously with the forward feeding. It is claimed that reductions from 2 in. to ½ in. and in similar proportion can be accomplished in a single pass. Unusual quantity production is also claimed compared with drop forging. No flash is produced and the original bar fiber is retained. MS (4b)

Tools for Heavy Forging. Ronald Benson. *Mechanical World & Engineering Record,* Vol. 94, Dec. 8, 1933, pages 1183-1184. From the large range of tools needed for heavy forge work, the main tools are dealt with in detail. The large hollow forging is an achievement of recent years, and in this connection the author deals with the usefulness of vee tools, which tend to produce a tube which is loose on the mandrel. Kz (4b)

Investigations into the Hot-Drawing of Seamless Steel Tubes (Untersuchungen über das Warmziehen [Kratzen] von nahtlosen Flussstahlrohren) Anton Pomp & U. Schylla. *Mitteilungen Kaiser-Wilhelm-Institut für Eisenforschung,* Düsseldorf, Vol. 16, No. 5, 1934, pages 51-64. Hot-drawing of tubes is the drawing of the preheated tube through dies in which process a reduction of the section is obtained by reduction of the diameter while the wall thickness is maintained. The problem was to determine the most favorable conditions with respect to angle of the orifice of the die, reduction of section and drawing temperature. The tests, made on a steel of 0.37% C, 0.44% Mn, 0.24% Si, 0.012% P and 0.018% S, are described in detail; the resistance to deformation is calculated by the equation: $K_w = P/[q_1 \times \ln (q_0/q_1)]$, where P the measured drawing force, q_0 and q_1 original and final section resp.; the tests were made at 700°, 800° and 900°C. Decreasing section reduces the resistance to deformation at 700° very greatly, at 800° only for small decreases while for larger decreases and at 900° the deformation resistance is no longer changed. For the same reduction of section and angle of the die the deformation resistance decreased with temperature; the minimum resistance is reached at an angle of 20°. Tensile strength, elastic limit, elongation and reduction of area are practically unchanged with decreasing section at different temperatures; also notch-toughness remains nearly constant. 10 references. Ha (4b)

Drawing & Stamping (4c)

Influence of Multi-Axial States of Stress On the Deformability of Metallic Materials (Der Einfluss mehrachsiger Spannungszustände auf das Formänderungsvermögen metallischer Werkstoffe) E. Siebel & A. Maier. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, Dec. 23, 1933, pages 1345-1349. Stress conditions as occurring in most practical cases are not 2-axial (in a plane) but multiaxial. These multiaxial stresses reduce the susceptibility of materials for being deformed to a great extent. The special case of deformation of tubes is experimentally investigated and the course of stresses during the whole duration of deformation measured. Diagrams for the stresses in longitudinal, radial and circumferential direction are reproduced. It is shown that even under 2-axial tensile stress the deformability of a material can drop below the value determined in the ordinary tensile test. 3-axial stress conditions can be more favorable so that the material will stand greater deformations. 9 references. Ha (4c)

Effect of a Backward Pull Upon the Tension Required to Draw Wire. Kenneth B. Lewis. *Wire & Wire Products,* Vol. 9, Feb. 1934, page 55. Observations on the paper by Thompson (see *Wire & Wire Products,* Dec. 1933) and some comparisons with his own experiments are given. It is pointed out that both the factors in die pull, the force required to deform and the external friction, depend directly on yield point of the material. The counter weight is a fixed value while the amount of work in the die varies. Test with various die angles, reduction, surface conditions, agree well with those of Thompson. Ha (4c)

A Note on Deep Stamping Defects. C. H. Desch. *Sheet Metal Industries,* Vol. 7, Sept. 1933, pages 293-294. The two types of defects are fine wrinkles, and "stretcher strains." The first is due to coarse grains which result from the removal of carbon during annealing. Normalizing has been found to give better results in subsequent cold pressing than does annealing. A small amount of cold working before pressing will further tend to prevent stretcher strains. 10 references. AWM (4c)

Impressions of a Consultant Engineer on Tours of Continental Ferrous and Non-Ferrous Tube Works. Gilbert Evans. *Metallurgia,* Vol. 9, Jan. 1934, pages 70-72. Describes equipment at several European plants. JLG (4c)

Recent Progress in Non-ferrous Seamless Tube Manufacture. Gilbert Evans. *Metallurgia,* Vol. 9, Feb. 1934, pages 117-120. Deals with mechanical and engineering progress. JLG (4c)

Punching and Stamping of Metals (Découpage et Emboutissage des Métaux) *L'Usine,* Vol. 42, Jan. 20, 1933, pages 27-29. Formulas and charts are given developed from actual experience for the calculation of number of passes, energy required and material required for drawing and stamping certain shapes. Tensile strength and shearing strength of different materials are given in a table. Ha (4c)

Enameled Sinks Pressed from Heavy-Gage Steel Sheets. *Steel,* Vol. 93, Aug. 7, 1933, page 28. Youngstown Pressed Steel Co. manufactures kitchen sinks of 1-piece formed steel construction, finished in acid-resisting white enamel. They are light weight without sacrificing strength or rigidity. Company also manufactures 1-piece milk cans by first deep drawing the shell and then forming the neck by spinning. Bottom is welded to can proper. MS (4c)

Cold Forming the Stainless Steels. A. E. R. PETERKA. *Metal Progress,* Vol. 24, Oct. 1933, pages 35-38. Freedom from seams, lubrication and the best quality of steel in dies is recommended for the cold forming of screws and fasteners from stainless steels. Heat treating temperatures for the various sizes and compositions are given. Roll threading, pickling, and inspection of finished products are described. WLC (4c)

Lubrication in Cold Drawing Sheet Steel. H. A. MONTGOMERY. *American Machinist,* Vol. 76, Oct. 12, 1932, pages 1056-1058; *Sheet Metal Industries,* Vol. 6, Feb. 1933, pages 652-654; *Heat Treating & Forging,* Vol. 18, Dec. 1932, pages 695-698; *Metal Stampings,* Vol. 6, Jan. 1933, pages 18, 34; *Machinery,* N. Y., Vol. 39, Jan. 1933, pages 348-350; *Mechanical World & Engineering Record,* Vol. 93, Aug. 18, 1933, page 788; Aug. 25, 1933, page 809. See *Metals & Alloys,* Vol. 5, Mar. 1934, page MA 102.

AWM + Ha + RHP + MS + Kz (4c)

The Plastic Deformation of Metals. F. KÖRBER. *Engineer,* Vol. 153, May 13, 1932, pages 538-539; *Engineering,* Vol. 133, May 20, 1932, pages 597-598; *Mechanical World & Engineering Record,* Vol. 91. May 27. 1932. pages 514-517. See *Metals & Alloys,* Vol. 5, Mar. 1934, page MA 104.

LFM + Kz (4c)

Shears and Saws in Rolling Mills (Scheren und Sägen in Walzwerken) HUBERT HOFF & F. HILGENSTOCK. *Zeitschrift Verein deutscher Ingenieure,* Vol. 78, Mar. 3, 1934, pages 271-277. Development of shears in their different forms of hydraulic and electrically driven ingot and bloom shears, flying shears, etc., is reviewed and modern construction described. Saws find only a limited field of application, a few constructions of hot and cold saws are described.

Ha (4c)

Continuous Punching, Forming and Assembling on Automatic Machines. FRED H. COLVIN. *American Machinist,* Vol. 77, Aug. 16, 1933, pages 522-525. Examples illustrate how multi-slide machines can produce a multiplicity of small parts with relatively inexpensive die changes. Several machines are described.

Ha (4c)

Fabrication of Dished Pressure Vessel Ends (Die Herstellung von gekümpelten Böden) E. BOTHMER. *Zeitschrift für Schweisstechnik,* Vol. 23, Dec. 1933, pages 300-302. For pressure vessels operating under high internal pressures, rounded ends are essential. The preparation of these ends is a difficult problem. The author suggests placing the plate to be dished in a pattern, heating it with the welding torch, and hammering it to shape. He gives cost data for material, labor and gas consumed in dishing a silo end 3600 mm. in diameter made of 5 mm. sheet. RRS (4c)

The Manufacture of Tinplate Containers. T. E. *Mechanical World & Engineering Record,* Vol. 95, Jan. 26, 1934, pages 69-70; Feb. 2, 1934, pages 104-106. The manufacturing process of tinplate containers, the construction and treatment of typical dies, and the machinery used are described in detail.

Kz (4c)

A Machine for Gold Beating. *Metal Industry,* N. Y., Vol. 32, Feb. 1934, page 58. A description of a machine for gold beating is given. PRK (4c)

Machining (4d)

H. W. GRAHAM, SECTION EDITOR

Precision Machining in Surgical Scissors Production. HERBERT R. SIMONDS. *Iron Age,* Vol. 131, Apr. 27, 1933, pages 660-663. Discusses the production of surgical scissors by the Bard-Parker Co., Croton Falls, N. Y. The scissors consist of forged stainless steel handles which carry renewable steel cutting edges in milled grooves. Handles are precision machined and are pivoted about a hardened stainless steel screw. Renewable cutting edge is made from C steel. In machining 10 separate cuts are required, with tools thin enough to clear an opening 0.013″ in width. To form cutting edge 12 passes in a roll stand are needed. Descaling is done by Bullard-Dunn process. Handles are heat treated in a Bellis liquid bath and cutting edges are heat treated by a continuous process. VSP (4d)

Formation of Chips and Surface Quality (Spanentstehung und Oberflächengüte) A. WALLICHS & H. OPITZ. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, Aug. 26, 1933, pages 924-926. The formation of chips in drilling and turning and the changes in the shape of tool and chip at different cutting speed were studied by taking microphotographs. An increasing chip thickness could be observed with increasing cutting velocity which cannot be explained very readily.

Ha (4d)

Reducing Tool Costs by Using Alloy Steels. RUSSELL P. WHITE. *Machinery,* New York, Vol. 39, June 1933, pages 661-663. General discussion of the use of S. A. E. 52100 and S. A. E. 3140 steels for tools in place of more expensive tool steel. Somewhat more care is required for heat treatment. Gives a few examples of specific operations. RHP (4d)

Drilling Tests on Light Metals (Boorproeven met lichtmetalen) *Polytechnische Weekblad,* Vol. 27, June 29, 1933, pages 414-415; *Der Betrieb,* Vol. 11, Nov. 17, 1933, pages 469-472. Reports on drilling tests of Stoewer with Al, Elektron, and Silumin relating to a study of drilling speed, shape of drill, diameter of drill and depth of drilled holes. Drilling of light metals permits higher working speeds than applied to steel. 300 m./min. are permissible with reference to a hole of d = 12 mm. and depth = 5 d. on Al and Silumin, while the velocity can be raised further on Elektron. In case of very deep holes, the speed must be cut down to 50 m./min. (Al, Silumin) and 25 m./min. respectively (Elektron). The most suitable cutting angle of the edge proved to be 100° and 140° for Al + Elektron and Silumin respectively. The twist of the drill was varied between 0° and 45° and the axial pressure and turning moments were registered. WH (4d)

Behavior of Metals During Cutting. F. SCHWERD. *Iron & Coal Trades Review,* Vol. 127, Aug. 18, 1933, page 245; *Mechanical World & Engineering Record,* Vol. 93, Sept. 15, 1933, page 890. The results of photographic investigations with an exposure of 1/5000000 second as applied to 3 phases of metal cutting: (1) how to obtain best finish, (2) what is needed to give closest tolerance, and (3) how to do the cutting most economically, are described and discussed.

Kz + Ha (4d)

Power Tools for Metal Working. H. WEINTRAUD. *Engineering Progress,* Vol. 14, July 1933, pages 125-128. Tools are now operated at speeds up to 70,000 r.p.m. Considers tools for grinding, filing, drilling, milling and special type screw drivers. Illustrates and describes the main features of these tools, and discusses drives. RHP (4d)

Recent Developments in Broaching. *Machinery,* London, Vol. 43, Mar. 15, 1934, pages 701-705. The recent advancements in broaching practice have been made possible to a large extent by the development of hydraulically operated broaching machines because the hydraulic power gives smooth action as well as the speed desirable for high rates of production. The principal advantages of broaching are a high degree of finish, the machining of work to close tolerances, long tool life, low cost per piece, and high production. Various broaching operations, with particular reference to external operations on crankshafts, cylinder blocks and connecting rods are described as well as the construction of the broaches used.

Kz (4d)

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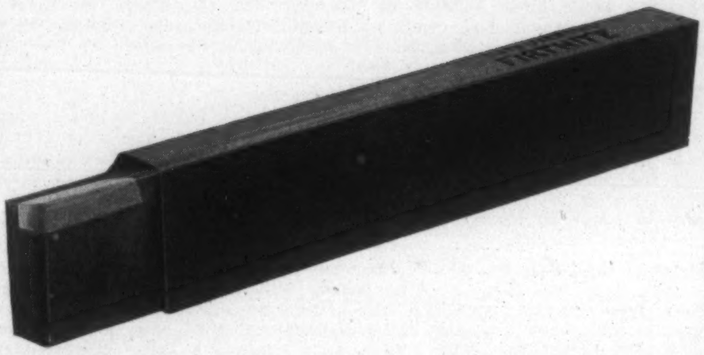

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Machining Operations on White "Pan Cake" Type Engine. F. L. PRENTISS. *Iron Age,* Vol. 132 Aug. 3, 1933, pages 12-15. Describes machinery and method used in machining parts for a motor bus engine of radical design at the plant of the White Motor Co., Cleveland. VSP (4d)

Better Precision Work in Automobile Manufacture (Grössere Herstellungsgenauigkeit im Automobilbau) KURT PLEGER. *Deutsche Motorzeitschrift,* Vol. 11, Sept. 1933, pages 170-174. Confines itself to a critical discussion on drilling operations involved in the manufacture of automobile engines. EF (4d)

Cutting Pressure and Life in Turning Alloy Structural Steel (Schnittdruck und Standzeit beim Drehen legierter Baustähle) H. PLAGENS. *Archiv für das Eisenhüttenwesen,* Vol. 7, Feb. 1934, pages 483-487. In lathe turning tests of a number of structural alloy automotive steels the cutting pressure and the cutting speed to give a 1 hr. tool life were determined. A relation was found between the two, so that within limits, the cutting speed for a 1 hr. tool life could be ascertained by measuring the cutting pressure. SE (4d)

The Trend of Machine Tool Design. J. PICKIN. *Railway Engineer,* Vol. 54, Dec. 1933, pages 369-370. The advance of W carbides is stressed. Although W carbides cut metals at much higher speed than ordinary high-speed steels, its edge breaks down rapidly if there is any vibration in the work or the tool or any slip in the main or feed drive. The structural features devised to make capstan and combination turret lathes suitable for W-carbides are considered. Gun metal and P-bronze can be machined at speeds up to 2000 ft./min., the "limit being what the machine will allow." Advances made or contemplated in machine tool design are summarized. WH (4d)

Developments in Railway Machine Tool Practice. N. H. PARKER. *Railway Engineer,* Vol. 54, Dec. 1933, pages 367-368. Points discussed: adoption of tangential dies, higher speeds on work on firebox stays, possibility of rolling threads on Cu stays, increase of productive efficiency by eliminating operator's fatigue and cutting down handling times of heavy work tools, exploitation of multi-drilling, grinding of cylindrical work without a chuck or centres, efficient jigs and fixtures to insure interchangeability. The modern trend is now definitely in favor of the universal machine. WH (4d)

Finish of Solid Bearings. M. P. DALTON. *Machinery,* London, Vol. 43, Nov. 30, 1933, pages 252-253. After dealing with the characteristics of machined surfaces, tests and experiences with solid bearings are discussed. Forced and scraped finished bearings show a greater life than machine-finished ones. Practical experiment confirmed that fine sharp cuts give, all round, a better bearing than a coarser cut made by a flat or round-nosed tool, although the latter gives the better apparent finish. Kz (4d)

Planing versus Milling. A. C. DANEKIND. *Mechanical World & Engineering Record,* Vol. 94, Dec. 8, 1933, pages 1172-1174. Surfaces may be machined, singly or in groups, on both planing and milling machines. Any job can be performed on either type of machine. The choice of machine is a matter of workshop economies. Kz (4d)

The Advantages of Planing and Milling Compared. FORREST E. CARDULLO. *Mechanical World & Engineering Record,* Vol. 94, Dec. 15, 1933, pages 1207-1209; Dec. 22, 1933, pages 1226-1227. So far as metal removal is concerned there are fields in which the planer excels and fields in which the milling machine excels. In the matter of rate of production the size, quantity and accuracy required must be taken into consideration. The effectiveness of first cost depends largely upon the rate of production, while versatility is measured largely by the availability of tools. Milled and planed surfaces have distinctive finishes which are suitable for different purposes. In some cases, when a surface obtained from both methods is desired, the combined planing and milling machine is often of outstanding advantage. Kz (4d)

Varied Practice in Surface Broaching. FRED H. COLVIN. *American Machinist,* Vol. 78, Apr. 11, 1934, pages 273-276. Broaching machines and their operation and construction are described. The cutting speed varies from 18 to 33 ft./min., tolerances are held within 0.001″ to 0.0005″. Ha (4d)

Performance of Cutting Fluids When Sawing Metals. O. W. BOSTON & C. E. KRAUS. *Iron Age,* Vol. 132, Dec. 28, 1933, page 11. Abstract of progress report No. 5 of subcommittee on cutting fluids of a special research committee on cutting metals of A.S.M.E., and read before the society in New York. Cutting fluids appreciably affect rate of dulling of W steel hacksaw blades. Shorter sawing times and least wear on saw blades were experienced when using sulphurized oils. The 1 to 50 emulsion was better than straight mineral or a mineral-lard oil. Tests were conducted on Peerless high-speed 9 in. capacity hacksaw. S.A.E. steel, cold drawn to a 1½″ square section was used in tests. Gives results of tests. VSP (4d)

Machining Hollow Drum Forgings. *Machinery,* London, Vol. 43, Nov. 16, 1933, pages 181-186. Deals with manufacture of hollow-forged steel drums as used for high-pressure boilers and for chemical and oil engineering processes. The material used is usually high quality mild steel having an ultimate strength of 28-32 tons/in.^{2}, or, as a higher grade, 34-38 tons/in.^{2} Where high stresses are involved special steels containing Mo are chosen and with these the creep limit is raised to a much higher level than in the case of straight C steels. Preparing the ingots for forging and the forging process are dealt with. For a very large forging as many as 8 or 9 heats are required, the drums, as forged, being subjected to an annealing process. Among others the manufacturing of a drum of 44 feet 5 in. length by 5 feet 3 in. in diameter and of 4.5 in. wall thickness from a cast ingot of 175 tons is discussed. The various machining operations involved in the production of different designs of drums are described. An equipment to test the wall thickness of drums at different points both radially and longitudinally is discussed in conclusion. Kz (4d)

Machining Operations on Diesel Engines. *Machinery,* London, Vol. 43, Feb. 15, 1934, pages 577-583; Feb. 22, 1934, pages 609-613. 2 articles describing methods and machines employed in the Swiss works of Sulzer Bros., at Winterthur. Kz (4d)

Machine Tool Developments. *Machinery,* London, Vol. 43, Dec. 14, 1933, pages 301-325. Illustrated discussion of the various machines used in metal-working shops. British, American, German and Swiss practices are covered. Kz (4d)

Tungsten Carbide Prolongs the Life of Machine Parts. *Machinery,* N. Y., Vol. 40, Oct. 1933, page 106. Application as grinder blades and tool tips due to its hardness and great compressive strength; examples are described. Ha (4d)

Unusual Application of the Hobbing Process. *Mill & Factory,* Sept. 1933, pages 29-31, 100. In this article it is pointed out by means of numerous examples how the hobbing process has been extended to include the cutting of a number of forms formerly considered impossible to hob. Kz (4d)

Modern Construction of Machine Tools (La Construction Moderne des Machines-Outils) *La Technique Moderne,* Vol. 25, Apr. 1933, pages 217-224. It is thought that progress cannot be hoped as to new principles of functioning of machine tools. Development will be noted in new increasing in cutting speed needing more and more careful construction with roller bearing and automatic lubrication in order to reduce wear and maintenance cost. It is suggested that W carbide or diamond tool working at high speed with small depth of cut will be probably substituted for grinding wheels in many finishing operations. However, improvements obtained recently in grinding wheels would allow construction of machines which could compete with lathes, planing and milling machines in current machining. FR (4d)

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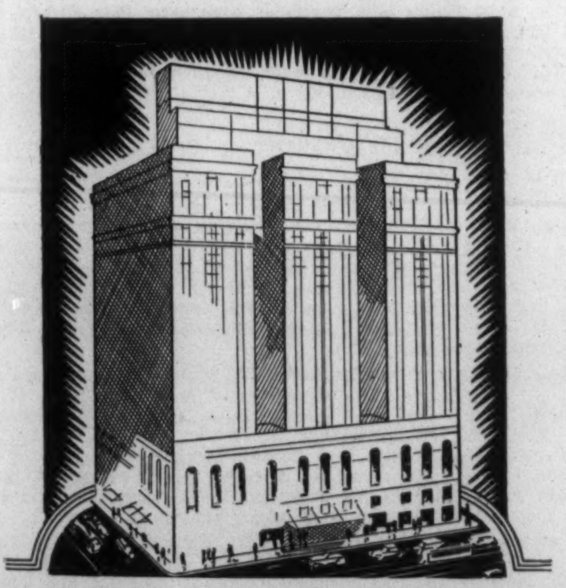

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1934 Will See Great Advances in Broaching. G. von Reis. *Machinery,* N. Y., Vol. 40, Jan. 1934, pages 257-263. Indications are seen that broaching will be a much more important manufacturing process in finishing of products than before. A number of recent applications are illustrated. Ha (4d)

Screw-Cutter "M.P." with Progressive Modulus for the Manufacture of Bevel Gears (La Vis Fraise M.P. à Module Progressif pour la Taille des Engrenages Coniques) P. Masson. *Arts-et-Métiers,* Vol. 85, Mar. 1933, pages 87-96. Description, theoretical explanation and computation of the new tool are given. FR (4d)

Effect of Lathe Cutting Conditions on the Hardness of Carbon and Alloy Steels. T. G. Digges. *Bureau of Standards Journal of Research,* Vol. 10, Jan. 1933, pages 77-78. The amount and extent of work hardening of forgings caused by lathe tools was determined by making hardness surveys with a Vickers machine. The hardness as close to the machined surface as it was possible to measure it was greater than the original hardness of the forging. Hardness decreased at increasing depths below the machined surface until it was the same as the original forging. Amount of hardening was not influenced by cutting speeds. Hardening was affected equally by changes in feed and depth of cut. See also *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 131. WAT (4d)

Fixtures for Tapping Small Parts at High Speed. H. Goldberg. *Machinery,* N. Y., Jan. 1934, pages 278-280; *Machinery,* London, Vol. 43, Mar. 1, 1934, pages 645-647. Tools and fixtures used in tapping nuts, small holes, etc. are described and illustrated in detail. Ha +Kz (4d)

Research on Use of Oils in Machining with and without Chips (Der heutige Stand der Forschung über die Anwendung von Oelen in der spanabhebenden und spanlosen Formgebung) Krekeler. *Die Metallbörse,* Vol. 22, July 13, 1932, page 883. Paper before Deutscher Verband für die Materialprüfung der Technik. See "Importance of Oils in Machining with or without Chipping," *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 132. EF (4d)

Develops Low-Cost Alloy for High-Speed Cutting. Zay Jeffries & W. P. Sykes. *Steel,* Vol. 92, Jan. 23, 1933, pages 19-20. Paper read before the Cleveland Chapter of the American Society for Steel Treating. Deals with alloy 548. See "Developments in Cutting Tools," *Metals & Alloys,* Vol. 5, Mar. 1934, page MA 101. MS (4d)

Fusion-Sawing (Schmelzsägen) H. Kaltenbach. *Zeitschrift Verein deutscher Ingenieure,* Vol. 78, Apr. 14, 1934, pages 478-479. Fusion-sawing is called a sawing process in which the saw (ribbon) runs so fast that the action of the teeth is similar to the grinding of an emery wheel. The best velocity of the saw is 50 m./sec., but 20 m. often suffice for ordinary purposes. The action is explained as follows: friction heats at first the bottom of the cut groove, a little material is ground off. Due to the very high energy supply to the small area of attack very little heat is lost and conducted away so that the material at the bottom becomes pasty and is easily chipped away by the sharp, hard teeth. A piercing sound is heard and sparks produced. The machine must be built very robust. Ha (4d)

Modern Metal Cutting Materials and How to Select Them. J. M. Highducheck. *Machinery,* N. Y., Vol. 40, Sept. 1933, pages 12-17. Compositions and properties of typical high-speed steels are reviewed and the points to be observed in selecting one for a definite purpose discussed on the basis of tests carried out by the Westinghouse Co. A nomogram is developed from which the most economical combination of feed, speed, and depth of cut can be taken. Examples illustrate the application. Ha (4d)

Figures on Sawed Surfaces. Kotaro Honda. *Metal Progress,* Vol. 24, Oct. 1933, pages 54-55. An explanation of the relief figures on metals cut with a hack saw is found in the set of the saw teeth. WLC (4d)

Analytical Control of "Soluble" Cutting Oils. E. E. Halls. *Industrial Chemist,* Vol. 10, Feb. 1934, pages 45-46. Methods are given for determining the various constituents and evaluating specific properties. RAW (4d)

Economics of Planing and Milling. R. E. Harrison. *Mechanical World & Engineering Record,* Vol. 94, Dec. 29, 1933, pages 1247-1248; Vol. 95, Jan. 5, 1934, pages 7-8. Deals with a method of comparison that will assist the executive, when confronted with the problem—to mill or to plane—to make a decision that will represent the soundest economics. Kz (4d)

Turning Driving-Box Brasses with Tungsten-Carbide Cutters. Chas. O. Herb. *Machinery,* N. Y., Vol. 40, Nov. 1933, page 156. Operation and lathe are briefly described. Ha (4d)

Developments in Small Gear Hobbers and Their Work-Holding Means. K. Glaeser. *Engineering Progress,* Vol. 15, Jan. 1934, pages 6-8. A few modern gear-cutting machines for high accuracy are described. Ha (4d)

Fine Drilling for the Manufacture and Reconditioning of Cylinders (Feinbohren zur Herstellung und Instandsetzung von Zylindern) Karl Göhmann. *Deutsche Motorzeitschrift,* Vol. 11, Jan. 1934, pages 18-20. The present state of fine-drilling is summarized and an up-to-date German drilling machine for automobile motor work described. EF (4d)

A New Machine for Milling Plate Edges. W. Fassbender. *Engineering Progress,* Vol. 14, Oct. 1933, pages 195-196. German regulations require plate edges, which are to be welded, to be machined only by planing. This is to avoid deformation of the material in the marginal zone. Slight deformation may occur when this method is used. Milling should not give this deformation. Describes a plate-edge miller built by the Maschinenfabrik Soest & Co. RHP (4d)

Machining Aluminum. W. B. Francis. *Metal Industry,* New York, Vol. 31, Sept. 1933, page 303; Oct. 1933, page 340; Nov. 1933, page 372. The technique of drilling Al is given. High speed twist drills should be used, having 140° point, keen cutting edges, increased angle of land, increased number of twists, high speeds, low feed, and a flood of soluble cutting oil or 50-50 kerosene-lard oil. Turning tools must have small angle on cutting edge, about 35-55°, 30-50° for front rake angle, and 6-10° front clearance and 10-20° side top rake, so as to remove chip with a shearing cut and deliver it diagonally clear of the work and tool in a rather straight piece. Planing tools have a round nose but blunt angles. For tapping, taps with helical flutes and with increased angles are used. Milling cutters should have 8° clearance, teeth undercut 10-20°, and helix of 25°. PRK (4d)

Materials for Modern Cutting Tools. J. V. Emmons. *Metal Progress,* Vol. 25, Dec. 1933, pages 35-40. A tool material must have a somewhat greater hardness than the material being cut though too great a hardness may be a distinct disadvantage. It should have sufficient strength and toughness to be readily fabricated and used without danger of breakage and have a cost commensurate with the work it will do. The author describes the applications of carbon tool steels, so called "special" grades, low alloy non-deforming tool steels (oil hardening), finishing steels for light, fine cuts (1.40% C, 4.0% W, with or without Cr, V, or Mo), high C-Cr (2.00% C, 12.0% Cr) tool steel for dies (may contain minor amounts of Co, V, and Mo.) For production tools where a red heat is generated in the chip high speed tool steels are indicated. 18% W, 4% Cr, 1% V is the most common variety used in this country. Modification contains Co and Mo. The possibility of a Mo base high speed tool steel is discussed. Non-ferrous alloys such as Co-Cr-W alloy "stellite" have long been available as a tool material. More recently developments have produced Fe-Co-W or Mo alloys having precipitation hardening characteristic for tool materials of high red hardness for high speed work. Various carbide materials are useful for cutting very hard or abrasive materials but are limited due to their brittleness. WLC (4d)

What Feed Shall I Use? Rob. C. Deale. *American Machinist,* Vol. 78, Apr. 11, 1934, pages 269-272. Machine feed as related to cutting efficiency and total cost is investigated, the results are shown in tables. Ha (4d)

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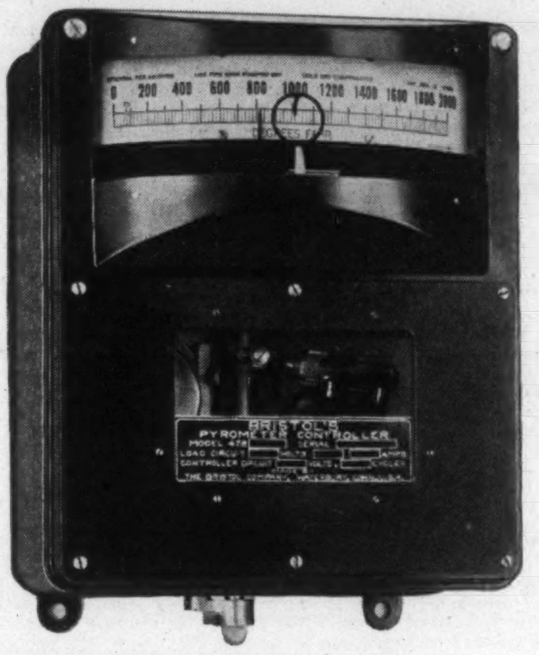

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HEAT TREATMENT (5)

O. E. HARDER, SECTION EDITOR

Changes in Form Caused by Heat Treatment. E. F. LAKE. *Heat Treating & Forging,* Vol. 20, Feb. 1934, pages 65-67. Investigated changes in density by determining sp. gr. of 22-gram specimens at 65°F. after heat treatment. Used 4 grades of C steel containing 0.20%, 0.50%, 0.85%, and 1.10% C respectively; 3 of Ni steel, containing 3%, 4%, and 5% Ni; 2 of Cr steel, containing 1% and 2.50% Cr; and 3 containing both Ni and Cr. Results are presented in charts and a table. After quenching and annealing, sp. gr. decreased as C increased, this being much more marked in the quenched steels than in the annealed ones. Changes were greater with H_2O quenching than with oil quenching. The sp. gr. decreased rapidly as the quenching temperatures rose from about 1425° F. to 1485°F. The higher the C content, the greater was this decrease. Above these temperatures the decrease was slight, while in the 0.20% C steel there was even a slight increase. An increase in drawing temperature raised the sp. gr. in proportion to the C content. The higher the C, the greater was the increase. Different drawing and quenching temperatures caused less alterations in the Ni and Cr steels than in the C steels. Changes in sp. gr. did not follow a regular curve when C steels were annealed and quenched for 5 consecutive times. MS (5)

Hardening Gear-Teeth. H. T. DAVEY. *Mechanical World & Engineering Record,* Vol. 95, Jan. 26, 1934, pages 73-74. Dealing with steels for case-hardening, data relating to the constituents and physical properties are given in tables. Selecting some examples, the author discusses the composition of compounds and the heat-treatment to be employed. The choice of steel is rather wider if the Shorter process is used and the hardening effect is limited to the surfaces where it is required. Nitrogen hardening is specially suitable to gear hardening because the distortion produced is extremely small and the steel is able to retain its hardness when the working temperatures are as high as 500° C. Kz (5)

Heat Treatment of Steel Gears. E. F. DAVIS. *Iron Age,* Vol. 132, July 27, 1933, pages 8-11. **Hardening and Cyaniding of Steel Gears.** *Iron Age,* Vol. 132, Aug. 3, 1933, pages 26-28, 32. From a paper read before the American Gear Manufacturers Association. In the first part author comments on forging, normalizing, annealing and carburizing of gears. Radial orientation of fibers of forged blanks is desirable. The temperature of forging is not as important as the amount of work and the finishing temperature. Gears annealed but not normalized show more movement in final hardening than gears which are both normalized and annealed. Principal cause of gear noise is lack of correct normalizing. Each type of steel must be annealed to some definite micro-pattern if maximum machining results are to be obtained. For carburizing the continuous rotary type, the straight through tunnel type, the counterflow and return counterflow furnaces are used. VSP (5)

Heat Treatment of Tool Steel. J. C. ALEXANDER. *Mechanical World & Engineering Record,* Vol. 94, Dec. 8, 1933, page 1175. Most faults in tools can be traced to inadequate pyrometric and atmospheric control during heat treatment. The author gives some simple rules (on how to create a neutral or slightly carburizing atmosphere and determine temperatures) the observance of which will help the tool maker who has to heat-treat steels without pyrometers and modern furnaces. Kz (5)

Controlled Atmospheres Find Wider Use in Heat Treating. *Steel,* Vol. 94, Jan. 1, 1934, pages 126-127. Reviews advances in heat treating during 1933. Progress was made in expanded application of controlled atmospheres; induction heating; nitriding; liquid bath heating; heat treating cast iron; better understanding of quenching; developing better steels; and improving temperature control equipment. MS (5)

Annealing (5a)

Annealing Diagram. ADALBERT JUNG. *Metal Progress,* Vol. 24, Sept. 1933, page 48. Diagram showing normalizing, softening anneal, spheroidizing anneal, and cold work relieving temperatures for carbon steels is reproduced superimposed upon the conventional iron-carbon diagram. WLC (5a)

Annealing Steel Blanks in a Controlled Atmosphere Cuts Cost of Formed Parts. M. W. BREWSTER. *Machinery,* N. Y., Vol. 40, Jan. 1934, pages 265-267. Describes operation of a blank-annealing furnace in which the atmosphere of mixed H and N is obtained by dissociation of NH_3. A 100 lb. cylinder of NH_3 produces approximately 4500 ft.^{3} of gas at a cost of $4.00-5.00/1000 ft.^{3} Ha(5a)

Hardening, Quenching & Drawing (5b)

Quench in Oil. G. W. PRESSELL. *Metals & Alloys.* Vol. 4, Oct. 1933, page 166. Comment upon quenching oils and their stability. WLC (5b)

Hardening With the Acetylene-Flame (Härten mit der Acetylenflamme) JOSEPH PLATZER. *Der Autogen Schweisser,* Vol. 7, Feb. 1934, pages 17-19. By means of examples, the simple manner of application of the acetylene flame for surface hardening is pointed out. Teeth of a gear are hardened by placing the gear half submerged into a water tank, with the axle in a horizontal position. Each tooth was heated to hardening temperature and quenched in the water by turning the gear. Kz (5b)

Quenching Springs in a New Emulsified Oil. SHINTA MATSUNAWA & MASULIRO SUZUKI. *Journal Society of Mechanical Engineers,* Vol. 36, Aug. 1933, pages 503-517. In Japanese. Paper before the General Meeting of the Society of Mechanical Engineers, Apr. 7, 1932. Discussion of experiments made by the Railway Research Office to improve the hardening effect by using a special emulsified oil as a substitute for expensive rape-oil or fish-oil. Springs of good quality can be obtained in one operation by quenching them in the emulsified oil from a required temperature, eliminating subsequent tempering. Kz (5b)

Oxy-Acetylene Flame for Hardening. J. H. CRITCHETT. *Iron Age,* Vol. 132, Dec. 28, 1933, pages 24, 64. **Heat Treatment with Oxy-Acetylene Flame.** *Metal Progress,* Vol. 23, Dec. 1933, pages 28-31. See "A New Process for Heat Treating of Rail Ends," *Metals & Alloys,* Vol. 5, Mar. 1934, page MA 94. VSP + WLC (5b)

Railroad Springs and Their Finish and Heat Treatment (Eisenbahn-Federn und ihre Fertigung) R. KÜHNEL. *Stahl und Eisen,* Vol. 54, Jan. 11, 1934, pages 25-29. Substitution of softer railroad springs, which set too easily, by a harder silico-manganese steel (0.40-0.55% C, 1.50-1.80% Si, 0.50-0.75% Mn) resulted in considerable breakage. In leaf springs this was traced either to uneven alignment of the springs or to decarburization in heat treatment. In helical springs surface defects caused the failures. In coil springs the failures occurred in the thin turns or in the transition from thicker to thinner turns, evidently due to the greater hardening of the thinner portions. Changes in design such as the insertion of an additional leaf in leaf springs are suggested. SE (5b)

Determining Hardening and Tempering Temperatures for Springs. E. BELL HARE. *Machinery,* N. Y., Vol. 40, Apr. 1934, pages 458-459. Tests on a certain kind of spring indicated as best method for hardening a salt bath at 1425-1450°F. and quenching in oil with subsequent drawing at 550-600°F.; the drawing temperature depends on the duty the spring has to perform. The hardening temperature must be increased with increasing Mn content. If a spring is plated it is necessary to subject it to a subsequent heating from 200-400°F. in order to dehydrogenate it and remove all defects caused by the plating process. One hr. at 400° suffices, at 200° 24 hrs. give best results. Ha (5b)

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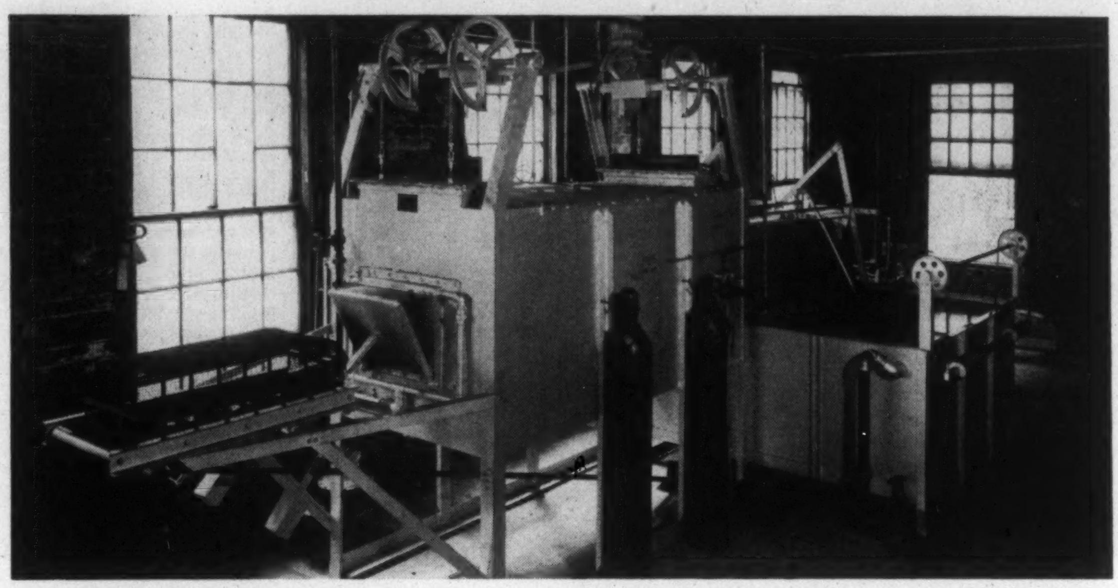

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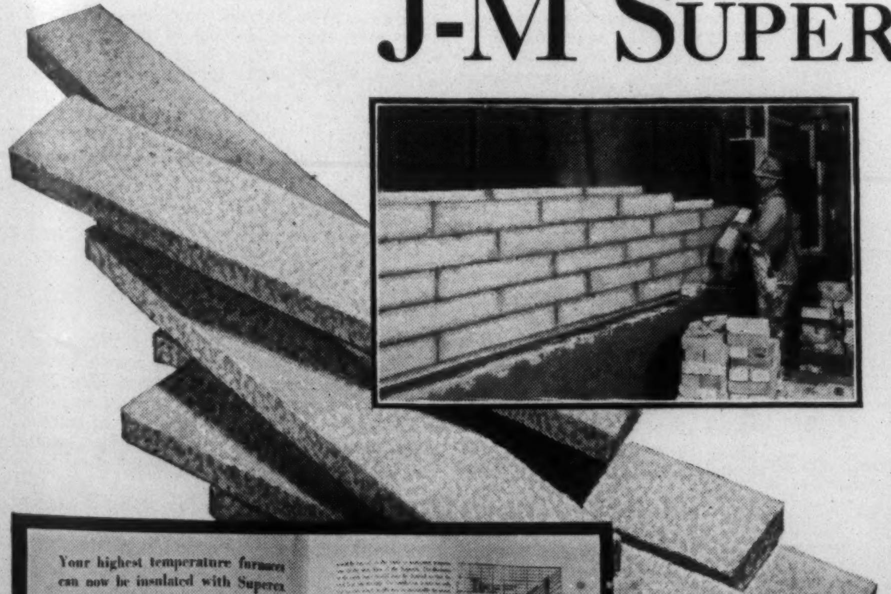

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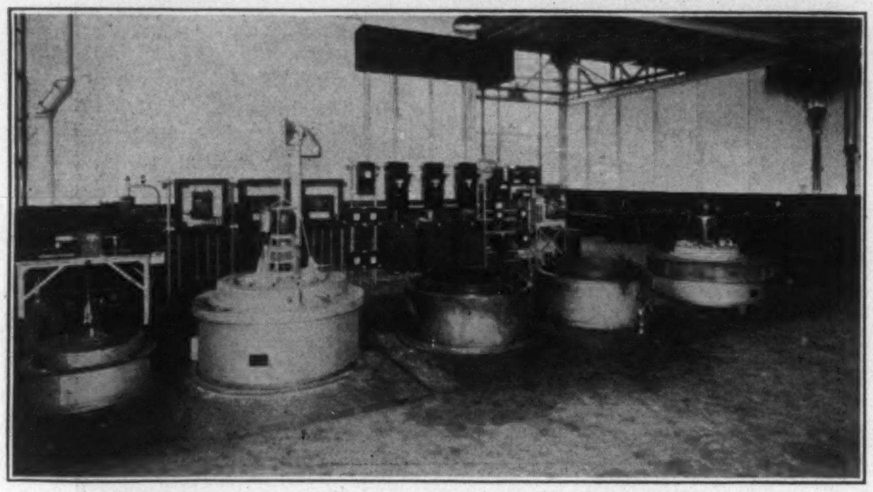

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Aging (5c)

Aging of Fine Sheets of Ingot Steel (Ueber die Alterung von Feinblechen aus Flussstahl) A. Pomp & Ottokar Klein. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Düsseldorf, Vol. 15, No. 17, 1933, pages 205-245. The effect of material, manner of annealing, little cold-deformation, different heat-treatments and final rolling temperatures on the tendency of fine sheets to aging was investigated. Killed material aged less than not-killed. Armco iron aged most, next was Thomas steel, while open-hearth steel aged least. Box-annealing showed the most unfavorable action, also normalized sheets aged fairly much. Slow cooling of the sheets was advantageous, twice annealed sheets (normalized and box-annealed) showed least aging. Sensitivity to aging decreased with reduced thickness of sheets. Straightening of the sheets acted like a cold-deformation with respect to aging. Subsequent cold-rolling caused aging corresponding to the degree of deformation. Artificial aging and heat-treatments as they occur for instance in galvanizing brought about changes of property depending on kind of material, annealing and deformation. To reach the maximum of aging a certain temperature and time is required; if these are exceeded or not reached values of aging are obtained which lie on the rising or falling branch of the aging curve. Heating of the sheets for galvanizing also changes the properties more or less. Higher final rolling temperatures favor aging. Numerous tables and charts represent all tests in detail; Rockwell hardness, tensile strength, elastic limit, elongation, deep-drawing capacity and notch-toughness have been measured. 9 references. Ha (5c)

Aging in Metals. C. H. Desch. *Metal Industry,* London, Vol. 42, May 19, 1933, page 515. See "Aging and Age Hardening in Metals," *Metals & Alloys,* Vol. 5, Feb. 1934, page MA 53. Ha (5c)

Carburizing (5e)

Eliminating Case-Hardening Failures. J. Winning. *Sheet Metal Industries,* Vol. 7, May 1933, pages 35-37. A short discussion of the methods available for carburizing; by solid carbonaceous substances, by molten carbon compounds, and by gases rich in carbon. The effect of time and temperature, the ideal case (about 0.9% C), and some common faults such as oxidation and overheating are discussed. AWM (5e)

Carburizing Small Parts by the Carbonol Process. E. M. Slaughter. *Machinery,* Vol. 39, Sept. 1932, pages 41-43; *Iron & Coal Trades Review,* Vol. 125, Oct. 7, 1932, page 541. This process consists primarily of heating the work thoroughly in a retort and then admitting oil which is caused to impinge on the hot walls of the retort by a rapidly revolving fan. The oil is thus transformed into an active carburizing gas. Describes equipment and operations at the National Acme Co. S A E 1020 steel was carburized at 1690° F. for 1, 2, and 3 hours with an oil drip of 135 drops per minute, and with an oil drip of 270 drops per minute. Gives depth of case and type of case for each time and treatment. Ha + RHP (5e)

Carburization in the Cupola Furnace (La Carburazione al Cubilotto) M. Kagan. *L'Industria Meccanica,* Vol. 15, Dec. 1933, pages 939-942. Carburization in the melting process of a cupola is explained: in order to keep carburization at a minimum melting must be rapid, the distance from hearth to tuyeres should be as short as possible, and the cast iron must be removed quickly from the action of the coke, i. e., must be taken out of the furnace as soon as possible. The amount of carburization depends on the nature of the charge, a charge poor in C will carburize more without reaching a very high content of C; with a charge of about 3% C carburization will be increased but be lower than expected, and with a charge with eutectic contents of C a decarburization takes place. These conditions are illustrated by tables giving the increase of C in per cent for various mixtures of pig iron and scrap steel; a practical average is:

% steel in the charge	22	25	50
% C in the charge	2.77	2.53	1.48
% C in the resulting cast iron	3.11	3.07	2.80
% increase in C	1.34	1.33	2.59

Carburization by cementation processes is compared with that in the cupola, temperatures up to 1400° C. have to be applied in order to obtain 0.9% C up to ¾ mm. of thickness of layer. Ha (5e)

Case Carburizing in Salt Baths (Die Einsatzhärtungen mit Salzbädern) R. Colell. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 24, Jan. 28, 1934, pages 42-43. Discusses case carburizing in general, outlines disadvantages of carburizing with solid compounds, deals in particular with advantages of salt bath carburizing: (1) considerable saving in wages and fuel costs, since this method is more rapid, (2) attaining of greater uniformity of all parts carburized simultaneously, (3) no distortions due to uniform temperature and uniform heating, (4) accurate temperature control, (5) no surface oxidation and scaling of carburized parts, (6) no formation of free cementite. These advantages and the possibility of continuous operation go to show that, in most cases, salt bath carburizing is superior to former method. Whereas it was formerly assumed that merely thin cases can be obtained by this method it is pointed out that cases up to 2 mm. thick can be produced in 4 - 6 hours. GN (5e)

Nitriding (5f)

Denitriding in Salt Baths and Molten Aluminum. H. H. Ashdown. *Machinery,* Vol. 38, Aug. 1932, pages 921-923. Nitrided steel heated in a bath of fused sodium potassium nitrate at 800° C. will soften from 1000 Brinell to 380. Heating in Al powder up to 660° C. is also successful. When parts of tool are to be treated all of it should be heated to 400-500° C. to avoid distortion or cracking. Change in hardness is mostly due to an inward diffusion of nitrides. Heat involved in die-casting of aluminum alloys has no softening effect on nitrided dies. RHP (5f)

Nitralloying Practice and Processes. Pt. II. J. W. Urquhart. *Heat Treating & Forging,* Vol. 18, Aug. 1932, pages 468-470. Discusses machining of nitriding steels, surface decarburization, distortion and warping during treatment, forging and stamping temperatures, advantages of and equipment for nitriding, and time required. MS (5f)

The Nitriding Process. *Engineer,* Vol. 156, Oct. 27, 1933, page 406. Brief summary of a paper on Nitri-cast-iron prepared by the Sheepbridge Stokes Centrifugal Casting Company of Chesterfield, England, and presented before the Scottish branch of the Institute of British Foundrymen, Oct. 14, 1933. LFM (5f)

Mechanical Properties of Surface Hardened Steels (Proprietà meccaniche degli acciai nitrurati) Iginio Transini. *L'Ingegnere,* Vol. 7, Nov. 1933, pages 805-811. A study of the resistance to fracture and the elastic properties of a nitrided soft steel, a nitrided semi-hard steel, and a Ni-Cr steel, to determine the influence of case hardening upon these properties. The results show that nitriding did not have a deleterious effect in any of the cases studied. 7 tables and 8 curves give the test results. RRS (5f)

Design of Nitrided Tools. Bernard Thomas. *Heat Treating & Forging,* Vol. 19, Dec. 1933, pages 93-95. Deals with the spalling of sharp corners of nitrided dies. This is attributed to the corner's acquiring a double hardness due to the penetration from the 2 sides of the angle. The difficulty can be obviated by rounding the corner. In a specific case, a corner was given a radius of about ¾ the total depth of hardness penetration obtained. The die performed satisfactorily thereafter. In cases where pressure and abrasion occur together, maximum tolerance should be allowed in the dimensions to reduce the effect of pressure to a minimum. MS (5f)

FURNACES, REFRACTORIES & FUELS (6)

M. H. MAWHINNEY, SECTION EDITOR

Thermal Studies of a Pig Iron Mixer (Wärmemesstechnische Untersuchungen an einem Roheisenmischer) L. Kaspers. *Archiv für das Eisenhüttenwesen,* Vol. 7, Feb. 1934, pages 445-453. **Thermal Conditions in Hot-Metal Mixers, Measurement of Heat Losses.** *Iron & Coal Trades Review,* Vol. 128, Mar. 23, 1934, pages 485-486 (Discussion). Time-temperature measurements in various parts of a 600-ton pig iron mixer were made, and the heat losses through radiation and conduction determined. Mention is made of the possibility of reducing these losses by surfacing the mixer with aluminum sheet and by better insulation. Ha + SE (6)

Permeability of Refractory Materials to Gases (Die Gasdurchlässigkeit von feuerfesten Steinen) F. H. Clews & A. T. Green. *Feuerfest-Ofenbau,* Vol. 9, Oct./Nov. 1933, pages 143-144. See *Metals & Alloys,* Vol. 3, Dec. 1932, page MA 360. EF (6)

3-Phase Electric Arc Furnace. Samuel Arnold. *Heat Treating & Forging,* Vol. 20, Mar. 1934, pages 143-146, 148. See *Metals & Alloys,* Vol. 5, Mar. 1934, page MA 110. MS (6)

Repairs to Steel Furnaces. Walter Lister. *Metallurgia,* Vol. 9, Mar. 1934, pages 145-147. Gives directions for making the bottom in basic and acid open-hearth furnaces. JLG (6)

Tar for Steel Plant Use (Stahlwerksteer) *Feuerfest-Ofenbau,* Vol. 9, Oct./Nov. 1933, page 143. Steel plant tar should have the following properties: (1) Great binding power to hold together the dolomite grains during ramming, (2) high C residue of 60-62% hard pitch, (3) smooth distillation curve to insure gradual baking, (4) absence of any dissociating fracture such as naphthalene (below 1%), (5) uniform composition. Ordinary coking tar should be distilled to approach the following volatile fractures:

Water	Up to 170°C.	220° (boiling)	230°	270°	300°	360°
0%	0%	1%	1%	6%	9.5%	30.5%

EF (6)

Industrial Heating. *Electrical Review,* Vol. 114, Jan. 26, 1934, pages 111, 113-114. Survey of the possibilities of electric melting and heating furnaces in the metal industries. They offer an enormous field of development. MS (6)

Heating Galvanizing Kettles by Diffusion Combustion. H. M. Heyn. *Steel,* Vol. 93, Nov. 13, 1933, pages 24-25. Pot is 8 ft. long, 2½ ft. wide, and 3 ft. 4 in. deep, and is inclosed by a setting 10 ft. 4 in. long, 6 ft. 11 in. wide, and 4½ ft. deep. It is heated by 2 diffusion combustion gas burners placed at diagonally opposite corners, 11 in. below the top of the pot to provide heat at the point where radiation losses are greatest. Burners fire in opposite directions along the sides of the pot, into ducts. Products of combustion travel through first duct, reverse direction and return to the burner end, where they reverse again and pass on out the flue. This installation replaced a coke-fired installation with the result that the amount of dross formed has been reduced 2/3, rate of heat transfer into kettle has been increased, fuel per hr. is less, kettle life is longer, and overall cost per ton of work produced has been materially decreased with an increase in quality. MS (6)

Buttweld Pipe Plant Arranged To Eliminate Backtracking. J. B. Nealey. *Steel,* Vol. 94, Jan. 8, 1934, pages 21-23. Describes plant and equipment of the Pittsburgh Tube Co., Monaca, Pa., with chief attention to the furnaces. There are 2 pipe-making units with regenerative-type, gas-fired furnaces. A gas-fired, walking-beam type of normalizing furnace handles small sizes of pipe. Galvanizing tank is set in a brick furnace with gas burners firing onto a refractory bed. MS (6)

How Gas Fuel Has Been Applied at the Tooele Smelter. J. B. Nealey. *Mining and Metallurgy,* Vol. 14, Sept. 1933, pages 375-376. Describes the use of gas as fuel at the plant of the International Smelting Co., Tooele, for roasting, reduction, sintering, drossing, smelting and for power. VSP (6)

Enameling In Automatic Gas Furnaces. J. B. Nealey. *Iron Age,* Vol. 131, June 8, 1933, pages 901-902, adv. sec. page 12. Describes an automatic gas furnace used by the American Stove Co. at its New Process-Reliable division, Cleveland. VSP (6)

Self-Regulating Induction Furnaces. *Mechanical World & Engineering Record,* Vol. 94, Nov. 3, 1933, pages 1054-1055. The feature of these furnaces, the working principle of which is illustrated by diagrams, is the physical constant used for temperature control, by which no variation of temperature can occur accidentally. Special alloy bars are fitted where they are subject to the furnace temperature. These bars lose their magnetism with rise of temperature and thereby diminish the input of energy to the furnace. Control is dependent solely on the composition of the alloy. Kz (6)

Use of Flexible Leads Provided with Water Circulation (Note sur l'emploi des conducteurs flexibles à circulation d'eau) *Journal du Four Electrique,* Vol. 43, Mar. 1934, pages 95-96. The use of seamless flexible tubes for cooling leads of high power electric furnaces by water circulation was started in 1926 on carbide furnaces. It was patented in France in 1928 and somewhat later abroad. Considerable advantages are claimed and the design is entirely practical. JDG (6)

Co-ordinated Heat Conservation at the Normandy Park Steel Works, Scunthorpe. W. J. Brooke. *Engineering,* Vol. 136, Dec. 29, 1933, pages 722-724. From paper read before the Iron & Steel Institute, Sept. 13, 1933. See *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 140. LFM (6)

Investigations of Inferior Fuels and Their Applicability (Untersuchungen minderwertiger Brennstoffe und ihrer Verwendbarkeit) K. Brueggemann. *Glückauf,* Vol. 70, Apr. 7, 1934, pages 317-321; Apr. 14, 1934, pages 341-346. Inferior fuels have now often to be used for economical reasons and it was investigated whether waste washings (from coal mining) contain enough heating value to justify their burning. Experiments led to development of a process and better analysis to use waste washings economically with an ash content of 40 to 60% in boiler plants. The losses increase with increasing ash content, the economical limit lies between 65 and 70%. Ha (6)

Passau Graphite as Refractory Material (Passauer Graphit für feuerfeste Zwecke) Erich Buchholtz. *Feuerfest-Ofenbau,* Vol. 9, Oct./Nov. 1933, pages 140-142. Refractory furnace materials have to meet requirements fundamentally different from crucible materials. Among the latter graphite plays an eminent role. The Flinz-graphite of the Bavarian Forest is particularly adapted, while amorphous graphite widely occurring is unsuitable for crucible manufacture. EF (6)

Forty Years of Combustion Research. W. A. Bone. *Journal Society Chemical Industry,* Vol. 52, July 14, 1933, pages 202T-209T. An excellent historical review. VVK (6)

New Type of Checker Brick Gives More Efficiency to Stoves in Blast Furnaces. Wm. M. Bailey. *Brick & Clay Record,* Vol. 84, Feb. 1934, pages 56-57. A new standard brick of special shape gives more surface area and does not make any stagnant spaces. Ha (6)

Note on the Utilisation of Blast-Furnace Gas. W. B. Baxter. *Engineering,* Vol. 136, Sept. 15, 1933, pages 318-320. From paper read before the Iron and Steel Institute, Sheffield, Sept. 13, 1933. See *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 138. LFM (6)

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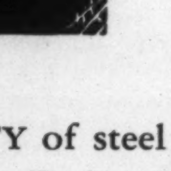

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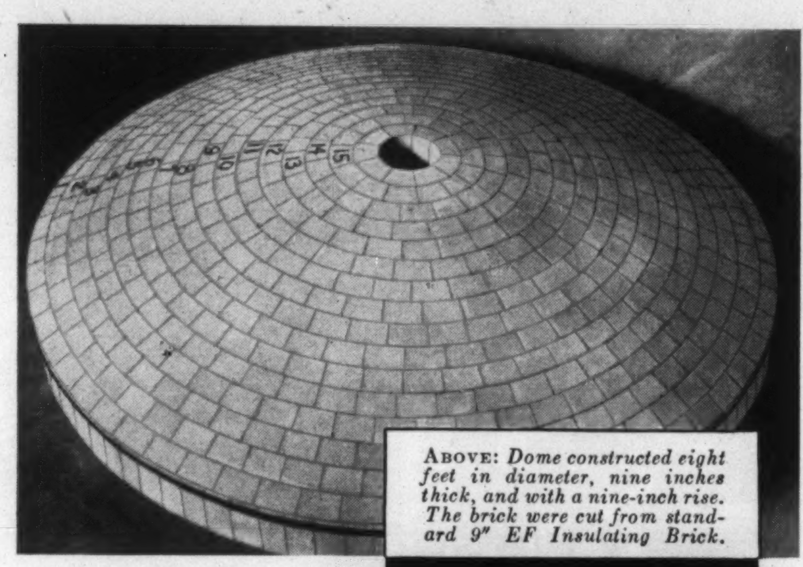

ABOVE: *Dome constructed eight feet in diameter, nine inches thick, and with a nine-inch rise. The brick were cut from standard 9" EF Insulating Brick.*

BELOW: *Another view of dome. The EF Brick were cut and laid up dry at our factory on a pile of wet sand contoured exactly in accordance with the plan for the dome.*

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Three Insulating Brick for Industrial Furnaces

Formation of Silicon Carbide (Die Bildung des Siliziumkarbids) K. ARNDT & E. HAUSSMANN. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 215, Nov. 10, 1933, pages 66-74. The formation of SiC was investigated with particular regard to the kind of raw material used; in the experiments, quartz and anthracite, charcoal or petrol coke were used. No difference between the 3 materials could be reported in the end product; the most practical procedure is to take anthracite because of the greater weight of the charge and therefore greater amount of SiC. Reduction of SiO_2 by C starts at 1600°C., the crystals formed grow with increasing temperature; they disintegrate again at 2250° whereby graphite remains in the form of the previous SiC crystals. The existence of the often assumed "siloxicon," a non-crystalline substance forming at 1600°C., could not be confirmed. It seems to be only a mixture of SiC and SiO_2 of very fine crystals. Ha (6)

Developments in the Construction and Operation of Soaking Pits (Neuerungen im Bau und Betrieb von Tieföfen) W. KREBS. *Stahl und Eisen,* Vol. 54, Feb. 1, 1934, pages 101-109; Feb. 8, pages 133-137; Feb. 15, pages 152-158. A very detailed critical account of the construction and operation of 12 soaking pit installations, giving construction costs, required space, repair costs, and the methods of heating. SE (6)

Study on Constant Temperature Apparatus. VI. A Simple Low-Temperature Thermostat. VII. A Note on the Controlling of An Electric Furnace. SHU KAMBARA & MOTOTARO MATSUI. *Journal of the Society of Chemical Industry, Japan,* Vol. 35, Apr. 1933, pages 134B-137B. The first article gives a description of an accurate and reliable thermostat. The second describes the control of an electrical furnace by an air bulb thermo-regulator, and the regulation of the thermocouple. MAB (6)

Utilization of Electric Energy in Recent Metallurgical Furnaces (Die Verwendung von elektrischer Energie in neueren Schmelzöfen) A. KARSTEN. *Die Metallbörse,* Vol. 23, Dec. 16, 1933, pages 1601-1603; Dec. 23, 1933, pages 1633-1634. Principles of low and high frequency furnaces, electrical data, and winding diagrams. High frequency furnace efficiency drops from 96% to 70-80% with Fe and steel melts, yielding an average of 90% during the whole melting procedure. With Ni the average efficiency is 85%, and 78% in the case of brass due to its high conductivity. The advantages of high frequency furnaces are summarized. EF (6)

On the Fundamental Formula of Designing Electric Furnaces. GORO HARADA. *Journal Society of Chemical Industry, Japan,* Vol. 37, Jan. 1934, pages 9B-10B. Resistance furnaces designed for producing pig iron from Fe ores with reducing agents such as coke are described. The discussion concerns the electrodes used for such furnaces and the formulae involved. MAB (6)

Stress Relieving Furnace Handles 35-Foot Pipes. *Steel,* Vol. 93, Nov. 6, 1933, page 28. Describes furnace at Boulder Dam. Information is similar to that in article by Charles Longenecker in *Heat Treating & Forging,* Vol. 19, Sept. 1933, pages 21-22. See *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 136. MS (6)

Electric Furnace Is Retired After 15 Years of Service. *Steel,* Vol. 93, Nov. 6, 1933, page 34. Sivyer Steel Casting Co., Milwaukee, has installed a new 3½-ton 'Lectromelt furnace to take the place of one which made 32,844 heats totaling 111,438 tons. In the new unit, roof and superstructure are lifted from the body and swung sidewise 90° by hydraulic pressure, permitting entire charge to be dumped in by a bucket. MS (6)

Steelmakers Apply Insulation to Minimize Melting Costs. *Steel,* Vol. 94, Jan. 1, 1934, pages 121, 127. Reviews developments in open-hearth furnace practice and construction in 1933. These include methods of C. H. Herty, Jr., for control of FeO; full sloping back-walls; multiple pass checkers; and insulation of furnaces above the charging floor. MS (6)

The Design and Operation of Industrial Furnaces Using Gas, Oil and Electricity. S. N. BRADSHAW. *Association of Manchester Engineers, Transactions* Session 1932-33, pages 193-226. The design of a furnace with regard to choice of materials as influenced by heat losses through the walls is explained. Electric furnaces do not have the great losses of heat carried away by flue gases in the case of fuel fired furnaces. Value of recuperators and regenerators is discussed. Ha (6)

Refractory Cements with Silicon Carbide Base (Les Ciments Réfractaires à Base de Carbure de Silicium) F. CROSET. *Arts-et-Métiers,* Vol. 85, Mar. 1933, pages 101-104. Article comprises following chapters: (1) General data on SiC. (2) Manufacture of SiC. (3) Properties and uses of SiC. (4) Refractory cements obtained with SiC. Cements are composed of SiC and suitable binder which can be maintained in good condition only if they are kept in tight vessels. Dry cements which are mixed with water only at time of making linings are also available. Example of ramming lining of an oil crucible furnace is given. In this case it is said that 1500 melts can be obtained with the same lining. FR (6)

Wire Rod Baker Operates with Controlled Atmosphere. *Steel,* Vol. 94, Feb. 19, 1934, pages 30, 32. Installation at plant of National Screw & Mfg. Co., Cleveland. Designed and built by Morrison Engineering Co., Inc., Cleveland. MS (6)

Insulating Refractories Gain More General Application. *Steel,* Vol. 94, Jan. 1, 1934, pages 132-133. Reviews developments in the refractories industry in 1933. Most significant feature has been more widespread adoption of semi-refractory insulating brick in various types of melting furnaces. MS (6)

Acid Lining for Melting Non-ferrous Metals in High Frequency Furnaces (Saures Futter zum Schmelzen von Nichteisenmetallen in Hochfrequenzöfen) J. A. KLJUTSCHAREW & S. A. LÖWENSTEIN. *Feuerfest-Ofenbau,* Vol. 9, Dec. 1933, pages 157-158. Laboratory and service condition tests on acid linings for non-ferrous metals. The corrosion resistance was determined against an 80/20 Cu-Ni alloy (1300°C.). The experimenters recommend the following synthetic mixture as a substitute for the widely used Eisenberger Klebsand: Clay, 12%; glass, 15%; ground sand, 30%; natural sand, 33%; coarse grained quartz, 10% (100-400 mesh/cm.^{2}). The presence of extremely finely ground glass is rather essential since it seals the cracks in the lining and prevents its perforation by the metal bath. The maximum moisture content for the crucible bottom is 6-6.5% and 5-5.5% for the crucible walls. The time of the first melt should be extended to 6-7 hrs. Thorough mixing of the ingredients is stressed. Careful drying with an electric coil for 2 days has been applied. EF (6)

Use of Revolving Furnaces for Small Steel Castings. F. GIOLITTI. *Metal Progress,* Vol. 25, Dec. 1933, pages 47-48. Low cost of installation, ease of operation, constant quality, and low production cost are given as advantages in the production of steel for small castings in the rotating furnace of the Brackelsberg type. WLC (6)

The Importance of Electric Heating in Industry (Die Bedeutung der Elektrowärmetechnik für die Industrie) G. DETTMAR. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, July 1, 1933, pages 693-694. A general discussion of advantages of electric heat application in manufacturing processes. Although the cost of electric current is often higher than other fuels this may be easily compensated by lower labor, fewer repairs, less waste. A few examples illustrate this. Ha (6)

Investigation into the Proper Distribution of the Heat Absorbing Area in a Hot Blast Stove (Untersuchung über die richtige Verteilung der Wärmespeicherfläche in Höhe und Breite in einem Winderhitzer) E. DIEPSCHLAG. *Feuerfest-Ofenbau,* Vol. 9, July-Aug. 1933, pages 97-99. Based on service data, the characteristics of a hot blast stove are evaluated. By re-arranging the same heating surfaces in regard to height and diameter, a comparison with the original air heater yields clues relating to further stove measurements and calculations. 6 references, 5 diagrams. EF (6)

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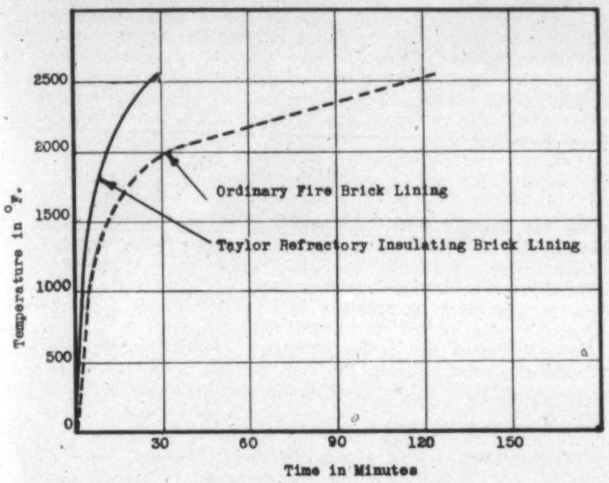

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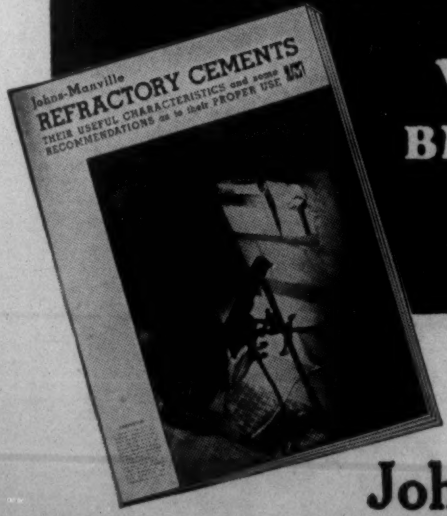
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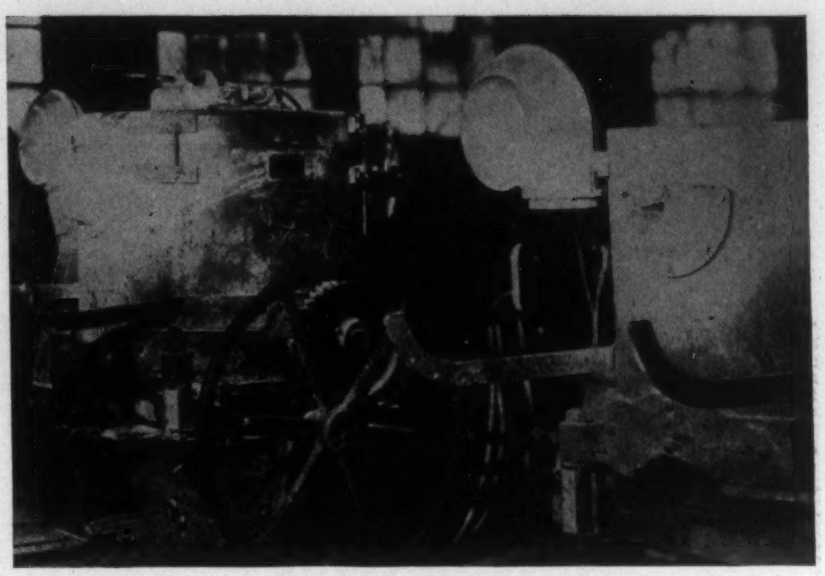

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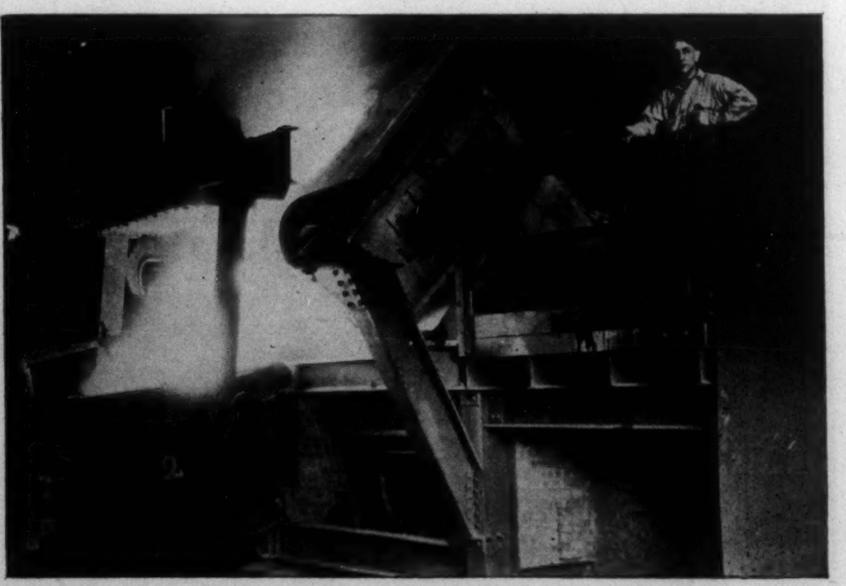

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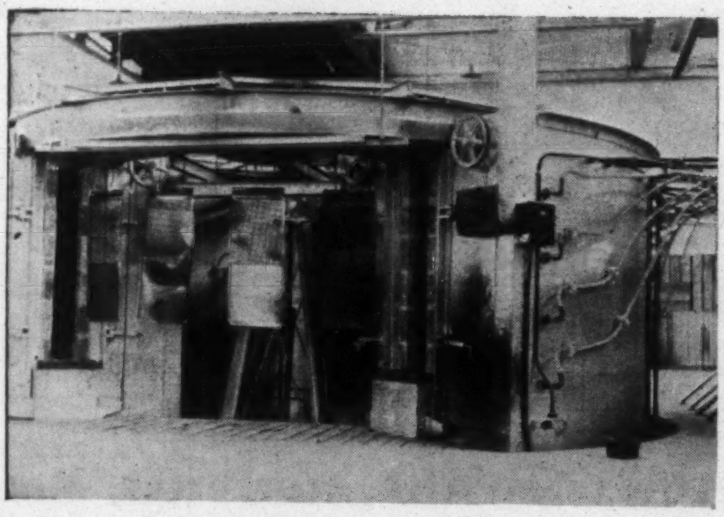

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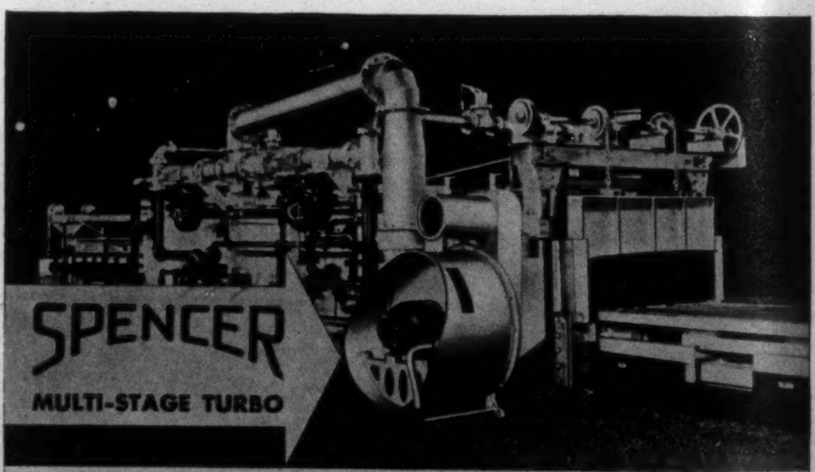
Insulation of Open-Hearth Furnaces. N. Allen Humphrey. *Blast Furnace & Steel Plant,* Vol. 22, Mar. 1934, pages 149-151. For successful insulation of open-hearth furnaces above the charging floor level, it is extremely important that temperatures within the furnace be controlled and that suitable insulating materials applied in the proper thickness be used. For example, if the temperature on the inner surface of a 6-in. thick silica brick roof is maintained at 3000° F., first layer of insulation should not disintegrate or shrink at temperatures up to 2600° F. and should not flux below 3000° F. Only sufficient thickness of this less expensive and more effective insulating material can be used. A high Al_2O_3 super-refractory insulating brick is very satisfactory for the first layer, a thickness of 2½ in. usually being efficient. If the second material can withstand temperatures of 1900° F. as is the case of monohydrate bauxite insulation, a thickness of 1¼ in. is about the limit. MS (6)

Development of Automatic Combustion Control Systems. J. L. Hodgson & L. L. Robinson. *Institution of Mechanical Engineers,* London, 1934. Paper, 5½x8½ in., 72 pages. Paper presented on January 26, 1934, before English mechanical engineering body, deals with principles and methods rather than with mechanical details, traces history, states lines of development, describes 13 of the more important European and American automatic combustion control systems, critically evaluates their characteristics, analyzes factors on which speed of response and accurate control depend, discusses elimination of hunting, sets forth considerations which affect the choice of mechanisms, reports test results, and urges desirability of installing automatic combustion control. Apparently, no manufacturer's own diagrams were reproduced but all of the 38 diagrams of systems and parts were especially prepared for this searching and comprehensive treatment. MFB (6)

Removing the Sulphur from Coke-Oven Gas by the Thylox Method (Entfernung des Schwefels aus Kohlendestillationsgasen nach dem Thylox-Verfahren) E. Koch. *Stahl und Eisen,* Vol. 53, Dec. 14, 1933, pages 1301-1305. By the thylox method recently developed by the Koppers Co. of Pittsburgh for removing S from coke-oven gas the S is obtained in a readily usable form. Treating all the German coke-oven gas in this way would yield enough S to more than supply the German domestic demand for S. In the thylox process the coke-oven gas is washed with an alkaline arsenic solution the H_2S present in the gas combining with the dissolved arsenic salt; on oxidation of the wash liquor part of the S separates out as colloidal S. SE (6)

Furnace Transformers. S. S. Cook. *Electric Journal,* Vol. 30, Sept. 1933, pages 359-361. Transformers for the operation of electric furnaces are subject to exacting conditions. The currents are large, short-circuits are not uncommon, current surges are heavy and uninterrupted service is required. Transformers for operating electric steel furnaces are usually designed for 10 to 12 low voltages ranging from 70 to 24 volts. Half of these are obtained by applying constant high voltage to different taps in the high-voltage winding connected in delta and the other half by applying the high voltage to the same taps with the high-voltage winding connected in star. One or two of the higher voltages are used for melting down the charge and one or two of the lower voltages for refining and holding the heat. When proper voltages have been determined for the conditions involved connections can be easily changed during the run. In order to stabilize the arc to avoid "wild" furnace operation considerable reactance is required in the circuit especially during the melting period. Transformers are usually installed in separate room to keep out dust and since air circulation is limited they are usually water cooled. Winding details, coils and etc. are discussed. CBJ (6)



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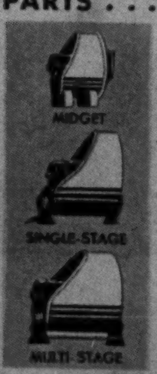

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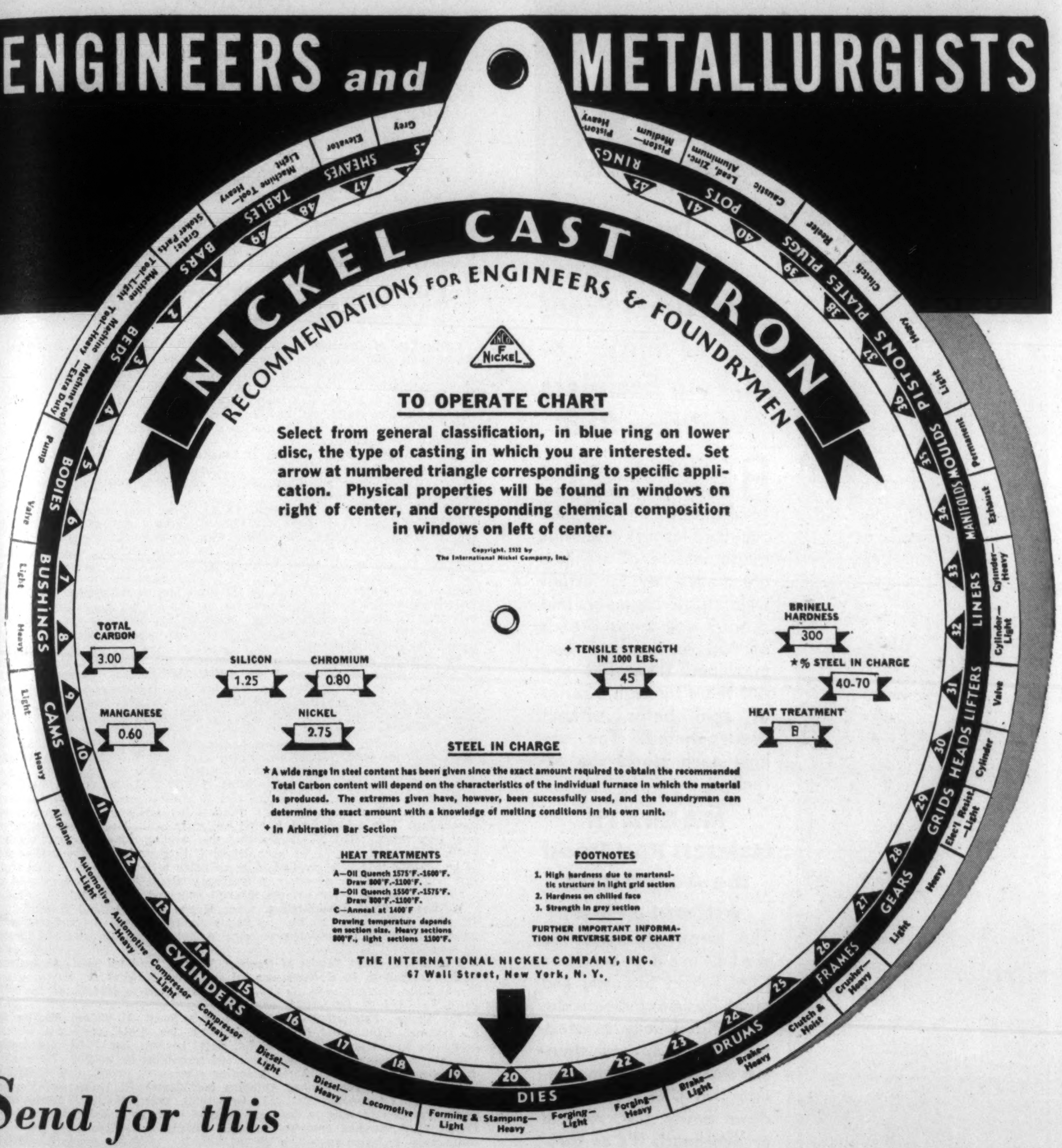
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JOINING (7)

Welding & Cutting (7b)

C. A. McCUNE, SECTION EDITOR

Influence of the Welded Material on the Porosity of Arc-Welds (Der Einfluss des Grundwerkstoffes auf die Bildung von Fehlstellen bei der Lichtbogenschweissung) F. Leitner. *Archiv für das Eisenhüttenwesen*, Vol. 7, Nov. 1933, pages 311-314. Plates 10 mm. thick were arc-welded with bare rimmed steel electrodes, and deep-etched sections through the welds examined for porosity. High rates of welding and rapid solidification of the fused metal caused increased porosity; higher current tended to reduce it. Steel with only traces of Si gave little porosity; Si contents from 0.1 to 0.3% tended to cause porosity, but with still higher Si contents porosity again decreased and was eliminated at about 0.6% Si. Increase in C and Mn content up to 0.4 and 1.7%, respectively, also eliminated porosity. SE (7b)

Welding Speeds Building of Golden Gate Bridge. C. B. Leahy. *Modern Machine Shop*, Vol. 6, Feb. 1934, pages 24-26. Torch-cutting and welding processes used in the construction are briefly described. Ha (7b)

Shaping and Welding (Gestaltung und Schweissung) W. Johag. *Autogene Metallbearbeitung*, Vol. 27, Feb. 1, 1934, pages 36-38. The consideration of properties of materials for the design of welded structures is discussed; utilization of space, welding methods applied, adaptation to purpose and space have to be considered to create properly manufactured structures and increase appearance and economy. Ha (7b)

Application of Nomographs to Calculations in Welding (Die Anwendung der Nomographie für die Kalkulation in der Schweisstechnik) L. Hunsicker. *Autogene Metallbearbeitung*, Vol. 27, Feb. 1, 1934, pages 33-36. The correct estimation of time required for certain welding work is of importance for the calculation of prices. It is shown how the variables, for instance, diameter of pipes, changes of angles, etc. can be taken care of in a nomogram from which the actual welding time and also preparation and cooling time can be read. An example illustrates the method. Ha (7b)

An Investigation of the Stresses in Longitudinal Welds. William Hovgaard. *Proceedings National Academy of Sciences*, Vol. 20, Jan. 1934, pages 17-23. Three theses from Mass. Inst. of Tech. are reviewed briefly and the results expressed mathematically. AHE (7b)

Gas and Arc Welds in Aluminum. G. O. Hoglund. *American Machinist*, Vol. 78, Jan. 31, 1934, pages 112-114. Present day practice of welding Al and Al alloys is reviewed. Gas-welding with oxy-hydrogen, oxy-acetylene or oxy-natural gas is applied with equal success, for heavier sections, over 0.25 in. oxy-acetylene is used as the higher flame temperature permits of faster welding, while for very light gages under 0.05 in. the 2 other gases are mostly used. The importance of a proper flux to break up the oxide film on the surface is pointed out. Electric arc welding prefers at present the metallic arc but the carbon arc promises well with automatic machine welding. Operation is faster than gas welding, costs are about the same. A table shows electrode diam. with current to be applied for various thicknesses of material. Ha (7b)

The Strength of Welded Joints, in Particular the Dependence of the Strengths on Shape (Ueber die Festigkeiten der Schweissverbindungen, insbesondere über die Abhängigkeit des Festigkeiten von der Gestalt) Hoeffgen & G. Bierett. *Autogene Metallbearbeitung*, Vol. 27, Jan. 15, 1934, pages 17-22. Discussion of paper (see Autog. Met. Vol. 27, Jan. 1, p. 1) by Graf. Some results with fillet welds are reported which show that shorter seams have a higher strength than longer seams; acetylene welds of 30 mm. length showed 35.5 kg./mm.^{2} (fracture in the seam), of 60 mm. length 31.8 kg./mm.^{2} (fracture in the seam), 90 mm. 27.0 kg./mm.^{2} (fracture in the material). The same experience was made with electric welds, the resp. figures being 41.8-35.2-27.3 kg./mm.^{2} The reason is found in the different ratios of seam stress to tensile stress of the rod; the strength of the seam depends greatly on its deformability and on the deformation of its surrounding. That welded seam is most uniformly utilized which can well equalize local overstresses, which also means that that welding material is best which possesses the greatest capacity for being deformed. In general, acetylene welding seemed to be superior to electric welding. A combination of butt weld with filled lap-weld gave very good results, especially in endurance fatigue tests. This is a weld where a piece of material is put between the butt ends and fillet welded. Ha (7b)

Welding in Plant Rehabilitation. Geo. Hettrick. *Welding Engineer*, Vol. 19, Feb. 1934, pages 19-22. Points to be observed in employing welding processes in repair and maintenance work in factories are discussed and illustrated by examples. Ha (7b)

Fluctuations in the Results of Hardness Tests of Hardened Steels (Schwankungen in den Ergebnissen der Härtemessung bei gehärteten Stählen) O. Hengstenberg. *Technische Mitteilungen Krupp*, No. 2, 1933, pages 40-43. See *Metals & Alloys*, Vol. 5, Feb. 1934, page MA 47. Ha (9b)

The Design, Fabrication and Erection of a Small All-Welded Machine Shop. C. Helsby. *Structural Engineer*, Vol. 12, Jan. 1934, pages 2-9. Paper before the Institution of Structural Engineers, London, Jan. 1934, abundantly illustrates and fully describes the design and assembling by welding of a small machine shop incorporating a 5 ton travelling crane. WH (7b)

Fusion Welding (La Soudure Autogène tout Court) R. Granjon. *Revue de la Soudure Autogene*, Vol. 25, Jan. 1933, page 2677. Author explains that terms used in order to designate kinds of welds are unduly adopted since the French term "soudure autogène" (fusion welding) is sufficient for welds which really resort to fusion process. FR (7b)

Tests for Judging Welded Structures (Versuchsergebnisse als Grundlage für Bemessungsregeln geschweisster Konstruktionen) O. Graf. *Stahl und Eisen*, Vol. 53, Nov. 23, 1933, pages 1215-1220. The testing of various types of welds, particularly fatigue testing is briefly considered. It is concluded that for static loading, the tensile strength of the joint may be used for judging the safety of a welded structure, and for dynamic loading the fatigue strength. SE (7b)

Strength of Welded Joints, in Particular the Dependence of Strength on Shape (Ueber die Festigkeiten der Schweissverbindungen, insbesondere über die Abhängigkeit der Festigkeiten von der Gestalt) Otto Graf. *Autogene Metallbearbeitung*, Vol. 27, Jan. 1, 1934, pages 1-12. Reports on tests made to determine the influence of the shape of a welded joint on the strength. Butt-welds are stronger when the weld is not vertical to the axis of the direction of force but under an angle to it. Properly arranged laps can reduce the stresses and give better distribution; this depends however on thickness of lap to thickness of material to be joined. The tensile strength of such joint is not increased by laps over the butt weld but the endurance strength is improved. Gas-fusion welding seemed to be superior to electric arc welding. The paper must be referred to for the many different forms of butt and lap-welds and their combinations. Ha (7b)

Electric Arc Welding in the Manufacture of Municipal Appliances. J. H. Gillett. *The Welder*, Vol. 6, Feb. 1934, pages 88-91. Application of welded containers in refuse collecting vehicles resulted in great saving of weight, neat and clean appearance, lessened cost of production (about 20%) and maintenance. Ha (7b)

Evolution of Fusion Welding as Seen in Technical Literature (L'Evolution de la Soudure Autogène et la Presse Technique) C. Franche. *La Technique Moderne*, Vol. 25, Aug. 1, 1933, pages 527-529. Review and summary of 21 articles published in American, English, German and French technical magazines. FR (7b)

The Arc Welding of Goods Wagons on the Victorian Railways. W. Featonby. *The Welder*, Vol. 6, Feb. 1934, pages 76-80. Detailed description of design and procedure. Ha (7b)

Electrically Welded Jetty in Budapest (Elektrisch geschweisste Landungsbrücken in Budapest) Enyedi. *Die Elektroschweissung,* Vol. 5, Feb. 1934, pages 38-39. Description of design, construction, calculation and deflection measurements upon test loading of 2 jetties recently built in Budapest. Results of test loading confirm that a welded construction is much more rigid than a riveted one. GN (7b)

Caisson Welding on the World's Largest Bridge. John H. Dodge. *Welding Engineer,* Vol. 19, Feb. 1934, pages 17-18. Erection and sinking operations are described. Ha (7b)

Present Position of Teaching of Fusion Welding (Ou en est l'Enseignement de la Soudure Autogène) A. Desgranges. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 4, Jan. 1933, pages 812-820. Lecture before the "Société des Ingénieurs Soudeurs." First, history of teaching of welding in France is made. Present position is then explained and it is shown that workers and engineers are well trained in the French "Welding Institute" and "Welding Technical School" but that training of foremen is somewhat defective. In last section of his lecture, author reviews present position of welding teaching in foreign countries and concludes that statistical data prove that welding applications are the most developed in France and that this is due to efforts more important than elsewhere which have been made for improving welding teaching but that much remains to do for developing welding teaching throughout French industry. FR (7b)

Electric Arc Welding. N. Grant Dalton. *Transactions South African Institute of Electrical Engineers,* Vol. 23, Dec. 1932, pages 343-345. See *Metals & Alloys,* Vol. 5, Jan. 1934, page MA 18. WHB (7b)

Fusion Welding in Remote Heating Equipments (La Soudure Autogène dans les Installations de Chauffage à Distance) M. Couturier. *Revue de la Soudure Autogene,* Vol. 25, Jan. 1933, pages 2682-2685. In modern heating equipment, heat is obtained in a central station and then distributed to houses or buildings through pipe lines joining of which is dealt with in present article. For these pipe lines, cast Fe is still used but steel tubes with welded joints and tested under inside pressure of 20 kg./cm.^{2} are today preferably resorted to. For diameters over 300 mm., steel pipe lengthwise water gas welded are used and for smaller diameters seamless tubes are adopted. Tube elements are welded together by means of oxy-acetylene welding. Test on a 400 mm. line with 5 mm. wall thickness has led to an elongation of 8 mm. in the weld which did not show any sign of weakness. This test corresponds to a stress of 2,800 kg./cm.^{2} which is of course never met in practice. Before welding, tubes must be thoroughly fitted together in order to have strong welds and to reduce loss of charge in the fluid inside of the tube. Size of welding torch is selected on approximate base of 100 liters of acetylene per hour and per millimeter of wall thickness to be welded. Close attention must be given to the problem of expansion of lines under heating. In a pipeline well designed stresses under thermal expansion must not exceed 7-10 kg./mm.^{2} at which welds work considerably under proof stress. Examples of dispositions for taking account of expansion are given. And examples of remote heating using welded tubes are also illustrated. FR (7b)

Atom-Physical Basis of the Phenomena in the Welding Arc (Atomphysikalische Grundlagen der Vorgänge im Schweisslichtbogen) H. von Conrady. *Die Elektroschweissung,* Vol. 5, Feb. 1934, pages 21-25. Whereas a number of fundamental investigations have elucidated the electro-physical occurrences in the carbon arc and mercury arc a lack of knowledge is observed as regards the physical occurrences in the welding arc, in particular the metal arc. The various theories on the electric occurrences in the metal welding arc are considered with special reference to the somewhat different conditions in the Arcatom arc. In the welding arc not only the physical occurrences are of importance but also the mechanical forces effecting transition of the weld drops. Author tries to explain these various forces and develops a theory giving an explanation for many occurrences observed in practical welding. GN (7b)

Stress Distribution in Fusion Joints of Plates Connected at Right Angles. E. G. Coker & R. Russel. *Engineer,* Vol. 155, Apr. 21, 1933, pages 394-397; *Werft, Reederei und Hafen,* Vol. 14, July 1, 1933, pages 185-186. See *Metals & Alloys,* Vol. 5, Feb. 1934, page MA 57. LFM + WH (7b)

Welding of Naval Aircraft Structures. Edw. W. Clexton. *Sheet Metal Industries,* Vol. 7, May 1933, pages 53-54. See "Welding in the Construction of Naval Aircraft," *Metals & Alloys,* Vol. 5, Feb. 1934, page MA 57. AWM (7b)

Review of Literature Dealing with Fusion Welding (Revue de la Presse de la Soudure Autogène) J. Brillie. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 4, Jan. 1933, pages 835-851. Account given before the French Welders' Association. Manufacture of following parts is explained: Steel poles (*The Welder,* Dec. 1932); Foot bridge (*Electric Welding,* June 1932); Purifiers (*Welding,* Oct. 1932); Water station (*Welding Engineer,* July 1932); Tanks (*Welding,* Dec. 1932); Suspended roofings (*Welding,* Oct. 1932); Welded frames (*Usine,* Jan. 1933); Tinning troughs (*Journal of American Welding Society,* Sept. 1932); High pressure separator and reaction chamber (*Babcock & Wilcox booklet*); Hg vapor boiler (*Welding Engineer,* Nov. 1932); Tank demolition through gas cutting (*Welder,* Nov. 1932); Special use for cutting torch (*Welding,* Dec. 1932); Pipe lines, (*Welding,* Oct. and Dec. 1932 and *Welding Engineer,* Oct. 1932); Oxy-acetylene welded Al tanks (*Dominion Ox-welding Tips,* Sept.-Oct. 1932); Budd & Michelin carriages (*Welding Engineer,* Nov. 1932); Budd process (*Welding Engineer,* Aug. 1932). Tubings (*Welding,* Sept. 1932); Concrete cutting disc (*Fusion Facts,* Oct. 1932); Heating Tubings (*Welding Engineer,* Nov. 1932). FR (7b)

Welding in Repair Work. C. W. Brett. *Electrician,* Vol. 111, Dec. 22, 1933, pages 773-774. Low temperature welding of cast iron and several applications in repair work are discussed. CBJ (7b)

Advance of Arcatom Welding (Entwicklung der Arcatomschweissung) Blomberg. *Elektrizitätswirtschaft,* Vol. 32. Nov. 30. 1933. pages 514-515. The characteristic features of this welding method are summarized and 3 illustrations show its utilization in boiler construction. Bending and flanging tests were successful. Overhead welding and vertical seams offer no difficulties any more. WH (7b)

Welding Longitudinal Seams of Shell Plating. L. C. Bibber. *Engineering,* Vol. 135, Jan. 27, 1933, page 111; *Transactions Society of Naval Architests & Marine Engineers,* Vol. 40, 1932, pages 149-195. See "Welding," *Metals & Alloys,* Vol. 5, Mar. 1934, page MA 95. Ha (7b)

Electric Welding for Reviving Small Shops During the Winter Months (Elektroschweissung zur Belebung des Kleingewerbes während der Wintermonate) H. Bauer. *Elektrizitätswirtschaft,* Vol. 32, Dec. 15, 1933, pages 529-532. Suggestions are furnished how electric welding could be advantageously used by the small shop owner and illustrates welding of furnaces, kettles, bottle washing machine drum, frame of cooling unit, glass roof skeleton, staircase, small boats, structural steel frame-work, built-up work on gear and urges utilization of electric welding for making benches, tables, vessels, ash containers, wheels, frames, supports, flanges, cases, etc. Cast and malleable Fe, Cu, brass, bronze and Al can be electrically welded. The latter method exhibits less warpage than oxy-acetylene welding, is more economical in heat utilization and cheaper if 1 kwh costs less than 15 pfennigs (about 6 cents). WH (7b)

Cutting Chrome-Nickel Steel Risers. R. B. Aitchison. *Industry & Welding,* Vol. 6, Sept. 1933, pages 12-14; *Machinery,* N. Y., Vol. 39, Mar. 1933, page 479. See *Metals & Alloys,* Vol. 5, Mar. 1934, page MA 97. RHP + Ha (7b)

Milk Station Tanks, Oxyacetylene Welded, Are of 18-8 Steel. *Steel,* Vol. 93, July 10, 1933, page 25. Warping of seams was overcome by flanging each edge about 3/16" at right angles to the main sheet for the full length of each section. Flanges were melted down to form the weld, no welding rod being necessary. Use of flux intended especially for high-Cr steels gives better results. MS (7b)

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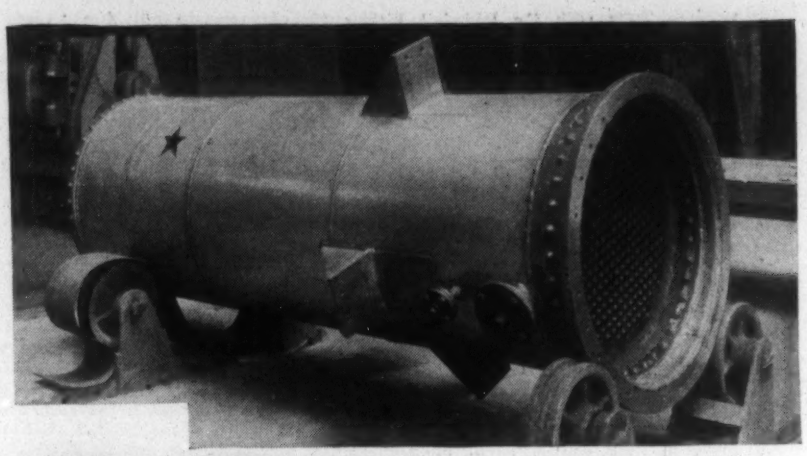

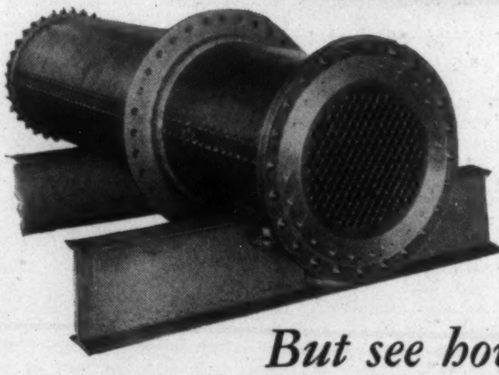

Above—*Heating element for Swenson Forced Feed Circulation Evaporator, sheathed with Nickel sheet. Electric welded with No. 31 INCO Nickel metallic arc welding rod. Nickel tubes and tube sheets.*

At Left—*Similar job, riveted construction.*

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for NICKEL-CLAD STEEL
(*for welding of nickel side*)

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Steel Frames for Diesel Engines. C. H. Stevens. *Report of Diesel Engine Users Association,* No. S. 110, Oct. 12, 1932, 33 pages; *Mechanical World & Engineering Record,* Vol. 42, Nov. 25, 1932, page 506. See *Metals & Alloys,* Vol. 5, Mar. 1934, page MA 97. JWD + Kz (7b)

Experiments with Cooled Acetylene Gas in Steel Flasks (Versuche mit gekühltem Azetylen-Flaschengas) Stephan Stark. *Autogene Metallbearbeitung,* Vol. 26, Dec. 15, 1933, pages 378-379. Acetylene gas in flasks (dissousgas) is dissolved in acetone which has in cold temperatures a considerably greater dissolving capacity for acetylene than at normal or higher. Experiments showed however that even at temperatures as low —26°C. the pressure and supply of the gas from the container was entirely satisfactory for uninterrupted welding. Ha (7b)

Welding Tests with the "Linde" Welder (Schweissversuche mit dem "Linde" Welder) E. Zorn. *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen,* Series 8, 1933, pages 23-30. The Linde Air Products Co. employs a welding method for steels with low or medium C content and steels with less than 1.5% Mn which utilizes the chemical properties of the C contained in a non-oxidizing oxy-acetylene flame; this C forms pure Fe and CO with the oxides of Fe, is easily soluble in Fe and easily absorbed in the hot Fe, reduces the melting point of the Fe-C alloy, increases the solidification range of Fe-C mixtures, and protects other alloying constituents, especially in a reducing atmosphere. The flame is adjusted for an excess of acetylene, 97 parts of 0 to 100 parts of C_2H_2, against 104 0 and 100 C_2H_2 in the neutral flame. The welding rod can contain C from 0.05-0.50%, Mn 0.5-1.75%, Si 0.20-1.50%, according to the material to be welded. The method of procedure, preparation of the work, instructions for adjustment and selection of flame according to material, and examples are given. Ha (7b)

Welding in the World (La Soudure dans le Monde) P. Senn. *Revue de la Soudure Autogene* Vol. 25, Jan. 1933, pages 2690-2691. Matters reviewed are the following ones. (1) Test on a welded two branch tube (*Welding Engineer,* Nov. 1932). (2) Joining of high strength steels (*Elektroschweissung,* Oct. 1932). Repair of a locomotive cylinder by oxy-acetylene welding (*Mechanical & Welding Engineer,* Sept. 1932). Welded metal roofing *Welding,* Oct. 1932). Changes in form of the metal brought by the arc (*Mechanical & Welding Engineer,* Aug. 1932.) FR (7b)

A Preliminary Research into the Effect of Heat Treatment on Welds. L. W. Schuster. *Proceedings Institution of Mechanical Engineers,* Vol. 124, Apr. 1933, pages 569-599. Includes discussion. This is the first report of the Welding Research Committee of the Institution of Mechanical Engineers. The committee expects to study the various effects that heat treatment has on welded pressure vessels. Considers the changes in toughness brought about by heat treatment. Deals with a trial set of tests made with a high class electrode, the results being intended as a guide for future research. The electrode core was of mild steel containing about 0.12% C and 5% Mn. It was covered with a heavy coating of Fe-oxide and silica in a proportion giving an acid slag, a half lap coating of white asbestos, among other ingredients the coating contained ferro-Mn for de-oxidizing and adding Mn synthetically to the weld metal. Several tables and photomicrographs show the heat treatment used and the results obtained. The Izod test seems to be suitable for showing changes that heat treatment may bring about in the weld metal. The shock value of the top run is considerably less than that of the lower runs. The good shock value obtained in the lower runs is largely due to the very fine grain structure. This structure can be secured in the top run only by a form of heat treatment that cannot be carried out practically. The best results after a heat treatment at 900°C. are possible only with a very rapid rate of cooling. RHP (7b)

Modern Welded Constructions for Chemical Apparatus (Neuzeitliche Schweisskonstruktionen im chemischen Apparatebau) Hugo Schroeder. *Chemische Apparatur,* Vol. 21, Feb. 10, 1934, pages 21-27. A collection of different designs, double cylinders, manholes, joints, supports, etc., made up by welding and cutting from solid metal is illustrated and procedure described. 8 references of descriptive literature. Ha (7b)

Manufacture of Agricultural Machine Frames by Welding (La Construction par Soudure des Bâtis de Machines Agricoles) R. Salelles. *Revue de la Soudure Autogene,* Vol. 25, Aug. 1933, pages 2840-2842. Details are given for a number of agricultural apparatus, particularly pulverizers in which frame and tank are constructed by arc welding. FR (7b)

Rebuilding Hammer Edges with the Oxyacetylene Torch. E. D. Soderstrom. *Welding Engineer,* Vol. 18, Dec. 1933, pages 28-29. Worn-off hammer edges are rebuilt by welding on new material; procedure is described. Ha (7b)

Use of the Shielded Carbon Arc Process. E. W. P. Smith. *Sheet Metal Industries,* Vol. 7, Dec. 1933, pages 495-496. The development of the shielded carbon arc is explained. The specific gravity of deposited metal is 7.84 to 7.86, well above A.S.M.E. code 7.80. Tensile strengths from 65,000 to 76,000 lbs./in.^{2}, and elongation of 20 to 30% in 2 inches of weld metal are obtained. Shielded carbon arc weld metal resists corrosion much better than non-shielded metal. AWM (7b)

Flame Cutting (Das Autogenschneiden) *Zentralblatt für die Zuckerindustrie,* Vol. 41, Aug. 5, 1933, pages 572-573. General survey on cutting of Fe and steel. EF (7b)

The Application of Electric Arc Welding by the Norwegian Government Railways. *Welder,* Vol. 6, Feb. 1934, pages 84-87. Design and procedures are described in detail. Ha (7b)

Electric Arc Welding on the Egyptian State Railway. *Welder,* Vol. 6. Feb. 1934, pages 82-83. Describes welded underframes. Ha (7b)

Electric Welding Practice in British Railway Shops. *Welder,* Vol. 6, Feb. 1934, pages 68-72. Description of methods used and illustrations are given of a few British railroad companies. Ha (7b)

Electric Welding in the Construction of Sea-Going Trawlers. *Welder,* Vol. 6, Feb. 1934, pages 73-75. Description of satisfactory results for large trawlers of 155 ft. length. Ha (7b)

Application of Correct Design, Good Welding, and Field Testing to Structural Work. *Welding Engineer,* Vol. 19, Jan. 1934, pages 21-23. Advantages and eventual savings of welded design are discussed in general and means described to test welded work in the field. Ha (7b)

Magnetic Investigation of Weld Joints and Work Pieces (Magnetische Untersuchung von Schweissverbindungen und Werkstücken) *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 24, Feb. 18, 1934, page 93. Brief description of new magnetic testing method of weld seams as previously outlined by Pfaffenberger, *Die Elektroschweissung,* Vol. 4, July 1933, pages 135-136. GN (7b)

Metallic Construction. Welded Steel Structure (La Construction Métallique. La Charpente Métallique Soudée) *La Technique Moderne,* Vol. 25, Jan. 15, 1933, pages 63-65. Properties of seams are reviewed and metal structure in different portions of welded seam is described then some examples of girders and posts made with welded plates, angles and other profiles are given. Numerous kinds of joints made possible by welding process are illustrated. FR (7b)

Coal Mining Company Uses Welding To Build Bridge of Old Pipe and Rails. *Steel,* Vol. 93, Sept. 25, 1933, page 30. Bridge in Wyoming, 393 ft. 4 in. long and 52 ft. high, was built by arc welding. MS (7b)

The Latest Developments in Applying Electric Welding to Ship Building (De siste nyheter i skibsbygning paa elektrosveisningens omraade) *Teknisk Ukeblad,* Vol. 81, Mar. 15, 1934, pages 169-171. An abstract of article by J. P. Wadling in *The Welder,* dealing with the use of electric welding in the construction of M/S Port Chalmers. Among the advantages gained by this method are greater strength, a more water-tight construction, and an appreciable saving in the tonnage of steel required. BHS (7b)

Absorption of Gas in Welding Probed. *Steel,* Vol. 93, Aug. 14, 1933, pages 27-28. **Westinghouse Laboratories Study Gas Absorption During Welding.** *Iron Age,* Vol. 132. Aug. 31. 1933, page 17. Weld pads are prepared in a special welding hood in which the atmosphere may be controlled. Interaction between gas and metal is studied by chemical and gas analysis of the deposited metal. Confirmed lower N_2 absorption in an atmosphere of 98% N_2 as compared with that in air. It is suggested that N_2 is absorbed by the metal in the form of an active N_2-0_2 compound. MS + VSP (7b)

Oxy-Acetylene Cutting as an Aid to Welded Design. H. Verson. *Welding Engineer,* Vol. 19, Jan. 1934, pages 13-16. Application of the cutting torch has made possible manufacture of parts according to a more theoretical line of design as is possible in castings. Many examples of machine tools, foundations, etc., are given as illustration. Ha (7b)

Economy of Torch Cut Parts Permits Refinement. L. R. Tufts. *Machine Design,* Vol. 5, Jan. 1933, pages 11-13. The torch cut process applied to the manufacture of a new paper folding machine is discussed in full detail emphasizing the following advantages of the oxy-acetylene cutting torch as a promising method in machinery building industry: savings by elimination of machining, flexibility of the method permitting changes on experimental units, reduction in weight without sacrificing but rather increasing strength. Gas cutting of the frames is accomplished by the pantograph method whereby the travel of the torch is controlled by a templet. Edges of the gas cut plates are readily smoothed by a hand grinder. Use of Mg for parts which must be lifted by the operator reduced the weight to 65% of the same assembly when an Fe casting was employed. WH (7b)

Built-up Welding and Its Utilization in Ship Engine Repair (Die Gussschmelzschweissung und ihre Anwendung bei der Instandsetzung im Schiffsmaschinenbau) Hans Türke. *Schiffbau, Schiffahrt und Hafenbau,* Vol. 34, Sept. 15, 1933, pages 321-323. Diagrams show data on bending strength, hardness and deflection of 5 different casting materials in the original, gas welded, hot, and cold welded state. The last method yielded decidedly inferior properties and should be dismissed. Illustrations refer to built-up work done on huge ship engine frames. High Si cast iron is used as welding material. The castings are slowly heated to and cooled from 800°-900°C. after welding at 1000 amps. and 40-60 volts. WH (7b)

Significance and Utilization Possibilities of Electric Welding for Small Shops (Bedeutung und Anwendungsmöglichkeiten der Elektroschweissung für das Handwerk) Straub. *Elektrizitätswirtschaft,* Vol. 32, Dec. 15, 1933, pages 525-528. Paper before the Berlin Section of the Verein Deutscher Elektrizitäts Werke, Sept. 29, 1933. Owing to the manual skill involved, electric welding offers an opportunity to small shops. The tendency of replacing castings by welded constructions also opens a new field to this branch of industry. A single built-up job sometimes justifies the installation of an electric welding equipment in a small shop. The numerous illustrations show partly typical reconditioning work done by electric welding and partly joining possibilities of more complicated nature in structural engineering. WH (7b)

12-Ton Rack for Sponge Ball Press Repaired by Thermit Welding. *Steel,* Vol. 93, Oct. 30, 1933, page 31. 600 lbs. of forging thermit was used. MS (7b)

Telescopes Are Housed in Welded Steel Buildings. *Steel,* Vol. 93, Oct. 16, 1933, pages 26-27. Structures for housing 2 telescopes at the United States Naval Observatory, Washington, D. C., have arc-welded framing and outer and inner sheet-steel coverings. MS (7b)

Training Good Welders (Pour Former de Bons Soudeurs) *Soudure et Oxy-Coupage, Supplement to Revue de la Soudure Autogene,* Vol. 10, June-Aug. 1933, page 185. Description of appliances used at the Institut de la Soudure Autogene for holding the job when welders are trained to weld upwards, downwards and in lying position. This operating in various positions has proved necessary for training good workers knowing best method to use in each case, for instance, in case of welding pipe lines in trenches. FR (7b)

Electrically Welded Boiler Drums. *Shipbuilder & Marine Engine-Builder,* Vol. 40, Sept. 1933, page 416. A review of the work by the Babcock & Wilcox Co. in the manufacture of boiler drums, pressure vessels, plant for chemical and oil industries, and pipe lines. JWD (7b)

Studies and Researches (Welding) (Travaux et Recherches) *Revue de la Soudure Autogene,* Vol. 25, Aug. 1933, page 2848. Summarized position of studies on welding processes dealing with following points (1) High strength feeding metal: Best results obtained on welded joints are, with Si-Mn alloy steel as feeding metal; ultimate strength 45 kg./mm.^{2}, elongation (in 4") 18-20% and with nickel steel; strength 55 kg./mm.^{2}, elongation 12-15%. (2) Destructive tests on welded vessels give always a fracture in the plate far from welded seams; more than 200,000 vessels made during the last two years have given no failure in service. (3) Intricate structures can be made with arc welding taking much care to prevent distortion and using special electrodes. (4) Tests made on torches having to resist high pressure show that much remains for improving torches tested. (5) Tests on acetylene generators are continuing and results will be reported later. FR (7b)

Welding in the World (La Soudure dans le Monde) *Revue de la Soudure Autogene,* Vol. 25, Aug. 1933, pages 2850-2851. Several abstracts from world technical literature are given and deal with following subjects: (1) Building of a welded bridge at Lanaye (Belgium) abstract from "l'Ossature Métallique" (no date). (2) Fusion welding in erection of airship mooring pole—abstract from "Welding" June 1933. (3) A new gondola for exploring stratosphere—abstract from "The Welding Engineer," June 1933. (4) An entirely welded tank barge—abstract from "Electric Welding," (no date). (5) Strengthening of a landing place for unloading coal—abstract from "The Welding Industry," (no date). FR (7b)

At the Show of Decorator Artists (Au Salon des Artistes Décorateurs) *Revue de la Soudure Autogene,* Vol. 25, Aug. 1933, page 2893. Incombustible pieces of furniture for steamers developed by "Société Studal" are illustrated. These pieces of furniture are made of solid bars of Studal alloy assembled through welding. Others are manufactured with welded light alloy tubes. FR (7b)

Research Works on Welding (Travaux de Recherches) *La Revue de la Soudure Autogene,* Vol. 25, Jan. 1933, page 2689. Review of research which are in progress at the "Office Central de la Soudure Autogène" (1) Study of protecting glasses for fusion welding : with an apparatus using a photo-electric cell, glasses can be classified according to their protective values for all kinds of rays. (2) Destructive tests of welded troughs under water pressure : A new apparatus for fatigue tests under water pressure is under construction. (3) Welding of 12% Mn steel : A new oxy-acetylene method has given good results and will be reported later as soon as practical value recognized. (4) Tests of acetylene generators : apparatus tested have all given good results. FR (7b)

Applications of Fusion Welding in Art Ironwork (Les Applications de la Soudure Autogène en Ferronnerie d'Art) R. M. *Revue de la Soudure Autogene,* Vol. 25, Jan. 1933, pages 2688-2689. In an article well illustrated application of oxy-acetylene welding in art ironwork is demonstrated. FR (7b)

Usual Method of Repairing an Old Bridge. *Railway Engineering & Maintenance,* Vol. 29, Oct. 1933, page 471. The methods employed in applying the arc-welding process to the reinforcement of chords of a bridge built in 1897 is illustrated in drawings and described in detail and emphasizes the peculiar working conditions of the repair job. WH (7b)

Oxy-Acetylene Cutting Regulations. *Oxy-Acetylene Tips,* Vol. 13, Feb. 1934, pages 29-34. The proposed rules and regulations (Bulletin No. 23, Code 1. Part A in the State of New York) for use of blowpipes in structural steel, definitions, qualification tests and cutting practices are discussed and explained by examples. Ha (7b)

Electric Welding in Lengthening the Ships of the "Albert Ballin" Division of the Hamburg American Line (Die Elektroschweissung bei der Verlängerung der Schiffe der "Albert Ballin"-Klasse der Hamburg-Amerika-Linie) *Die Elektroschweissung,* Vol. 5, Jan. 1934, pages 12-14. After considering efficiency to be attained by remodeling bow and lengthening ships by 12 m. parts electrically welded are considered. For the first time the joints of the outer skin plates were welded in a ship of large size. Chiefly non-coated electrodes were used with the exception of application of core electrodes in welding outer plates. In all 10,000 m. of seams were made. GN (7b)

The Electrically Welded Littoria Tower in Milano (Der elektrisch geschweisste Littoria-Turm in Mailand) *Die Elektroschweissung,* Vol. 5, Jan. 1934, pages 16-17. Describes details of welded construction of mentioned tower. See *Il Politecnico,* 1933, No. 8. GN (7b)

Automatic Arc Welding in Bridge Construction (Selbsttätige Lichtbogenschweissung im Brückenbau) *Elektrizitätswirtschaft,* Vol. 32, Oct. 15, 1933, pages 452-453. Describes how automatic electric welding was utilized on the longest bridge electrically welded in Germany (315 m. long). The following table compares manual and automatic welding:

Width of weld in mm.		Efficiency in m./hr.	
hand	automatic	hand	automatic
5	5	2	5
7	7	1.40	4
10	10	0.90	2
12	12	0.40	1

With reference to electrode consumption in kg./m. weld, automatic welding works 10% cheaper than hand welding. The tendency of utilizing thin, continuous welds instead of thick, broken beads in structural engineering speaks in favor of automatic machine welding. WH (7b)

Welding Cast Iron. *Automobile Engineer,* Vol. 23, Sept. 1933, page 331. Brief note on a process developed by Messrs. Barimar, Ltd. Does not give details of the method but states that gray iron castings and malleable cast iron can be welded at temperatures no higher than those employed in brazing by use of a special anti-oxide fluxing compound. RHP (7b)

Figures Which Speak for Economy of Electric Welding (Zahlen, die für die Wirtschaftlichkeit der Elektroschweissung sprechen) K. Ruppin. *Elektrowärme,* Vol. 4, Mar. 1934, pages 62-64. Time and energy required for electric welds of 1 m. length was determined as follows:

Thickness of sheet mm.	Consumption of electrodes number	Consumption of electrodes diam.	Time min.	Consumption kwhr.
4	8	3	about 22	about 0.9
6	8	4	24	1.5
8	6 6	3 4	38	2.4
10	6 8 9	4 6 3	54	4.2
15	8 10	4 6	80	5.6
20	12 13	4 6	90	8

Ha (7b)

Welding of Pipes for Central Heating (La Soudure des Canalisations de Chauffage Central) Rousselet & Meslier. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 4, Jan. 1933, pages 821-834. Report on work of a Committee having to study the question read before the French Welders' Association. Tests have been made in order to establish average costs for various sizes of tubes. Results can be summarized as follows: For tube sizes ranging from 12/17 mm. (inside and outside diameters) to 110/120 mm. time needed for making a butt joint varies from 1.20 min. to 9 min., acetylene consumption varies from 3 liters to 41 liters and that of oxygen from 3.5 liters to 49 liters. These results are compared with quite surprising ones published in "Welding" for similar experiments where times and gas consumption are nearly 10 times higher than those obtained in present tests. Other experiments have aimed to determine losses of charge of water in a tube with 10 welded joints as compared with that of similar tube of same length without joints. It is shown that these losses are very low and can be neglected in computations. In order to know strength of welds on tubes, tests have been made on welded tubes of various sizes; these tests have shown that breakage never appears at welded joints. Similar tests were made on same kinds of tubes after exposure of 120 hours in 10% KCl solution; breaking strengths obtained are somewhat lower than previously but breakage still appears always away from joints. In a last series of tests tubes of large sizes were given destructive tests under inside water pressure. Cracks appear always away from welded joints under pressure of about 350 kg./cm.^{2}, no leakage being noted before crack formation. FR (7b)

Automatic Welding of Containers (Maschinelle Schweissung von Behältern) E. Rosenberg. *Montanistische Rundschau,* Vol. 26, Jan. 16, 1934, pages 4-6. Description of an apparatus for automatic welding of containers, built for the Russian petroleum industry by Elin A. G., Vienna, and capable of welding pieces up to 5 m. long and of 600-1,840 mm. diameter and 7-25 mm. wall thickness. Welding rods of 4-5 mm. thickness are guided automatically by a Leonard machine. Two electrode holders are used, each fed by a machine of 300 amp. capacity; these may operate side by side on two different seams, or on the same seam, as desired. In 48 hr. this machine welded 22 containers of 1,500 mm. diameter; 5,000 mm. length, and 10 mm. wall thickness. BHS (7b)

Welding Applied to Oil-Well Drilling. M. L. Rogers. *Welding Engineer,* Vol. 19, Feb. 1934, pages 23-25. Examples are described. Ha (7b)

Applications of Welding to the Boilers, Piping and Equipment of a Mercury-Steam Power Plant. R. H. Rogers. *Welding Engineer,* Vol. 19, Feb. 1934, pages 26-28. Describes use of welding from the particular point of view in this case of absolute insurance against leaks in the pipes of mercury vapor. Ha (7b)

Automatic Arc Welding (Das automatische Lichtbogenschweissen) K. Ritz. *Die Elektroschweissung,* Vol. 5, Jan. 1934, pages 4-9. Points that favor use of automatic welding methods are first enumerated (1) lack of trained labor, (2) increased working capacity by higher amperage and welding speed, (3) improved quality of weld seams due to larger uniformity of welding process and better maintenance of working conditions, (4) independence of labor. Numerous automatic welding apparatus with Fe arc are then described and shown starting with first German automatic welding machine developed by Siemens Co. in 1915. With the development of automatic machines for welding of wheel rims the fundamental parts of such machines that are found in all later constructions were originated, the welding head and the steering mechanism. The following machines are considered: for welding straight seams, welding sleepers, machine for welding longitudinal and vertical seams, large portable welding machines, etc. Similarly carbon arc welding machines are discussed as those developed for automatically welding casks, air preheaters, rear axle bridges of automobiles, etc. GN (7b)

Progress of Welding in Steel Construction (Fortschritte der Schweissung im Stahlbau) W. Rein. *Der Bauingenieur,* Vol. 15, Jan. 5, 1934, pages 12-15. The essential, economic and structural advantages derived from application of welding in steel construction, surpass the disadvantages of welding. However, the reliability of riveted constructions cannot be reached by welding. The causes determining the lower fatigue properties of welded construction are outlined. Results of fatigue tests show that reliable conclusions cannot be drawn yet on best methods of shaping welded constructions. Of prime importance for reliable application of welded constructions are: porefree welding, avoidance of sharp cross-sectional transitions and means of decreasing stress maxima. GN (7b)

Welded Steel Diesel Structures. *Journal of Commerce (Shipbuilding & Engineering Editions),* Dec. 14, 1933, page 5. Welded steel crank-cases of high strength alloy steel show a saving in weight of 10 lbs. per horse-power in a 1000 h.p. engine and at the same time have an increased rigidity. JWD (7b)

Fusion Welded Steel Air Receivers. *Iron & Coal Trades Review,* Vol. 127, July 7, 1933, page 11. The British Specifications for stationary welded steel air receivers with respect to quality of material, tensile strength and elongation, number of joints, manner of making welded joints, butt welds and tests are discussed. Mild steel made by the acid or basic open-hearth process and less than 0.05% S must be used. Tensile breaking strength should be between 24 and 30 tons/in.^{2} with an elongation not less than 23% for plates ⅜" thick and more, and not less than 20% for plates below ⅜". General working instructions are given. Ha (7b)

Penstock Fabrication by Welding. *Engineering News-Record,* Vol. 111, Dec. 21, 1933, pages 751-754. Steel slabs up to 2¾" thick are bent and welded into 30 ft. diam. pipe in fabrication plant at the rim of Black Canyon for Boulder Dam. Following the completion of each welded joint every inch is photographed by X-ray for inspection. This will require the photographing and checking of over 400,000 lin. ft. of weld. Stresses are relieved by heating to about 1200° F. in an oil fired furnace. The pipe is accurately milled on the ends, shot blasted on the inside, given a primer coat of water-gas tar, and a final coat of coal-gas tar applied hot. Tests of weld samples are made in a completely equipped testing laboratory. CBJ (7b)

Automatic Arc-Welding for Mass-Production. *Engineering,* Vol. 136, Nov. 3, 1933, pages 485-488. Lengthy article showing photographs of and describing various types of machines made by different companies. LFM (7b)

Polish Specifications for Welded Steel Structures (Polnische Vorschriften für geschweisste Stahlhochbauten) *Die Elektroschweissung,* Vol. 5, Feb. 1934, pages 35-37. Specifications are considered under (1) specifications on calculation and operation, (2) design of welded constructions, (3) material used and welding personnel, tensile tests, bending tests and shearing tests, (4) keeping of welding manual. GN (7b)

Should Round or Square Welding Rods Be Used? (Soll man runde oder quadratische Schweissstäbe verwenden?) Lj. Petrovic. *Die Elektroschweissung,* Vol. 5, Jan. 1934, pages 10-11. In comparative arc welding tests for determining the chief properties of round and quadratic rods of cast Fe the following data were measured: weight of rods, length of rods, weight of melted rod, weight of remaining rods, welding time, time loss due to inserting new rods and interruption of arc, power consumption. Power consumption/kg. of melted electrode, electrode loss by oxidation and splashing, time loss in percent of pure welding time were calculated. Table shows results:

Cast Fe electrode	KWH/kg. electrode	Electrode loss in percent of electrode weight	Time loss in % of welding time
Round	3.17	12.39	6.91
quadratic	3.04	12.96	5.62

(1) round electrodes require larger power consumption than quadratic, (2) time loss with round electrodes is by far larger than that of quadratic, (3) electrode losses on account of oxidation and splashes are lower for round electrodes. The results are in favor of quadratic electrodes when production costs of electrodes are same, as holds true for non-coated electrodes used in investigation. GN (7b)

Welded Heating Boiler (Geschweisster Heizungskessel) R. Poensgen. *Autogene Metallbearbeitung,* Vol. 27, Jan. 15, 1934, pages 22-25. Construction of a low-pressure boiler for a central heating plant is described. Ha (7b)

Bronze-Welding a Large Gear. L. C. Monroe. *Welding Engineer,* Vol. 18, Dec. 1933, page 19. Cracks in a semi-steel crankshaft gear of a billet shears were successfully repaired by bronze welds with the electric arc. Ha (7b)

Comparative Study of Oxy-Acetylene-Welding and Arc Welding (Etude Comparative de la Soudure Electrique à l'Arc) R. Meslier. *Revue de la Soudure Autogene,* Vol. 25, Jan. 1933, pages 2678-2681; Mar. 1933, pages 2726-2728; Apr. 1933, pages 2746-2748; May 1933, pages 2770-2772; June 1933, pages 2794-2795; July 1933, pages 2818-2820; Aug. 1933, pages 2838-2839. Very substantial study giving opinions of leading manufacturers and engineers, together with numerous practical examples of applications as well as comparative results concerning applicability, value of joints obtained and cost for both types of welding. Conclusions of this long study can be summarized as follows: (1) Applicability: oxy-acetylene welding can be applied to all metals and alloys; steels, cast Fe, Cu, brass, bronze, Al, Ni, etc. On the contrary arc welding can only be resorted to for ferrous metals and more specially for steel. Therefore selection between the two processes must only be considered for steels. If it is a matter of butt joint or outside welding of angles, oxy-acetylene welding is to be preferred. On the contrary, for overlapping joints of inside welding, arc welding is considerably better and sometimes in the latter case only arc welding can be used. (2) Quality of welded joints: Both processes can give joints having properties required as to strength, ductility and fluid-tightness. The latter quality which was formerly always questionable for arc welded seams is now regularly obtained with method of numerous and superposed passes. On thin sheets (2-8 mm.) quality of oxy-acetylene welded joints is generally better than that of arc welded ones. On the contrary on plates thicker than 8 mm., arc welding properly made with quality feeding metal leads to joints generally more resistant than oxy-acetylene welding does if special feeding metals are not used with special method of application. Torch welding makes important progress on latter lines. (3) Cost: Author has extensively studied this question on numerous types of application and arrives at the following conclusions. When the two processes can be indifferently used, oxy-acetylene welding which is cheaper must be selected. Contrary to common opinion, arc welding requires more time than oxy-acetylene welding for making a joint of same quality. With the former, labor represents 45% of total cost, whereas with the latter labor is only 25-30% of total cost and improvements are to be hoped through better utilization of torch flame. Conclusively author points out that arc welding has been unduly used in numerous cases where oxy-acetylene welding would have proved preferable; the two processes are not to be considered as competitive ones. FR (7b)

Utilization Possibilities of Electric Welding (Die Anwendungsgebiete der Elektroschweissung) L. Kuchel. *Elektrizitätswirtschaft,* Vol. 32, Dec. 15, 1933, pages 522-525. Discusses and illustrates the adoption of electric welding in the following fields: (1) structural steel work, (2) vehicle construction, (3) ship building, (4) machinery, (5) tube and vessel, and (6) boiler construction. Weight comparison on a bridge recently built in Germany yielded for the 2 standard structural steels: St. 37 riveted = 100, welded = 83%; St. 52 riveted = 78%, welded = 68%. Due to these savings in weight, electrically welded bridges were about 12% cheaper than riveted ones; 25% of weight was saved on express cars and 30% on oil tankers. Further data on electrically welded jobs accomplished in Germany during the last years are given. WH (7b)

The Importance of the German Electric Welding Society for German Economics (Die Bedeutung der Deutschen Gesellschaft für Elektroschweissung für die deutsche Wirtschaft) F. Krahe. *Die Elektroschweissung,* Vol. 5, Jan. 1934, pages 1-3. The growing utilization of electric welding in the German industry is based on technical and economic advantages that are discussed. The following items are pointed out in particular: (1) development of welding apparatus and auxiliary equipment lead to establishment of new industries, (2) application of electric welding promotes other branches of industry, (3) electric welding increases consumption of electric power. The role that above mentioned society played in this development is discussed with special reference to training of welding engineers and welders. GN (7b)

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The British Welding Code. *Engineering,* Vol. 136, Oct. 6, 1933, page 390. Comments on a publication entitled: "British Standard Nomenclature, Definitions and Symbols for Welding and Cutting." This is specification No. 499 of 1933 of the British Standards Institution. LFM (7b)

The New Laboratory for Welding Technique of the Technical University Karlsruhe (Das neue schweisstechnische Laboratorium der Technischen Hochschule Karlsruhe) A. Kessner. *Autogene Metallbearbeitung,* Vol. 27, Feb. 1, 1934, pages 38-42. The building was erected by gas fusion welding; columns, structures and parts are illustrated and a drawing is reproduced showing the welder how to proceed. Ha (7b)

Welding Stainless-Clad Steel. Wm. B. Keelor. *Welding Engineer,* Vol. 18, Dec. 1933, pages 15-17. The process of manufacturing stainless-clad steel from 2 insulated stainless steel plates, welded together on their circumference and placed in a mold in which mild steel is poured on and around them, is described. Methods of welding thin sheets and plates by electric arc or gas are explained in detail and a few examples illustrated. Ha (7b)

Arc Welding in Machinery Construction (Lichtbogenschweissung im Maschinenbau) K. Jurczyk. *Die Elektroschweissung,* Vol. 5, Feb. 1934, pages 26-33. Paper before Tagung für Elektroschweissung, July 21, 1933, Essen. Author summarizes his experiences in applying arc welding to machinery construction, based on the results of year-long investigations. Considered are principal factors affecting fatigue properties of welded constructions. Sharp transitions in cross-section are very dangerous. By proper shape fatigue properties can be increased considerably. This is shown for 2 cases, joints of round and flat bars that were upset for increasing fatigue limit. Further tests refer to welding stresses. Change in length of weld seams at constant tension loads was studied. Practical examples confirm the conclusions drawn from the results of these investigations. The new welding principles developed were successfully applied in several cases, for instance, in welding the pillars of a church building, in welding a crane, in welding the roller bed of a rail mill, in welding a pump made of steel plate, in welding lever of a bar mill, guide box of a blooming mill, etc. GN (7b)

Welding by Means of Machine Tools (Schweissen mit Hilfe einer vorhandenen Werkzeugmaschine) A. Lion. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 24, Feb. 11, 1934, page 80. Shows how to apply a turning lathe to making longitudinal welding seams. GN (7b)

Riveting (7c)

Rivets Have High Tensile Strength Without Excessive Hardness. A. E. Gibson. *Steel,* Vol. 93, Oct. 2, 1933, pages 27-29, 37. Difficulty encountered in removing heads of countersunk rivets made of steel containing 0.30% C and 1.60% Mn led to an investigation of Cromansil steel for rivets. This was found to exceed greatly the requirements of U. S. Navy Department specification 43R1c and to be free from the detrimental quality of excessive hardness after driving. Laboratory investigation included tests of parent metal and of riveted joints in single shear, double shear, and tension. Two grades of steel were used, (a) containing 0.105% C, 0.68% Si, 1.17% Mn, and 0.38% Cr; and (b) containing 0.19% C, 0.60% Si, 1.10% Mn, and 0.30% Cr. In the single shear tests, the shearing load for (a) rivets varied from 73,700 to 82,500 lbs./in.^{2} and for (b) rivets, from 97,800 to 116,680 lbs./in.^{2} In the double shear tests, the shearing load for (a) rivets varied from 70,500 to 76,050 lbs./in.^{2} and for (b) rivets, from 90,050 to 106,350 lbs./in.^{2} Shearing load in double shear tests of an undriven rivet and driven rivet of (b) was 63,600 lbs./in.^{2} for the former and 112,200 lbs./in.^{2} for the latter. Tensile strength of driven (a) rivets was 124,000-131,700 lbs./in.^{2} and of (b) rivets, 135,000-161,000 lbs./in.^{2} Great increase in physical properties of Cromansil steel rivets indicates a beneficial effect of heat treatment which consists of heating the rivet to the necessary riveting temperature and cooling it rather quickly by contact with the cold piece. Working of the steel in the upsetting operation also imparts a beneficial effect. Hardness tests of driven rivets indicate that rapid cooling of the rivet in contact with the hole increases the hardness of both rivet and bar. Rockwell B hardness increased from 75-77 near head of an undriven (a) rivet to 98-102 at about ½ in. from head of driven (a) rivet. Hardness of undriven test-bar was 85-86 and that of driven bar around rivet-hole was 98. Photomicrographs show refinement in grain structure brought about through heating and cooling of the rivet in contact with the part being riveted. Author's opinion is that this steel is the best available for high tensile rivets and particularly so for application requiring flat head rivets to be finished flush with the work. MS (7c)

Corroded Cover Plates on Deck Girders Replaced. *Railway Engineering & Maintenance,* Nov. 1933, pages 546-547. Corrosion of the top flanges of the girders of five 84 ft. 6 in. deck spans of the Missouri-Kansas-Texas bridge over the Arkansas river at Osage, Okla., gave rise to a repair job that was completed without the use of false work. although it involved the renewal of all parts of the cover plates in the top flanges that had exposed surfaces. The repair work done by riveting is fully described. WH (7c)

Hydraulic Riveting and Its Effect on Boiler Materials (Das hydraulische Nieten und sein Einfluss auf die Kesselwerkstoffe) H. Stehr. *Maschinenschaden,* Vol. 10, 1933, pages 137-144. Mechanical and thermal effects during riveting, which can hardly be avoided, cause aging defects in heat treated C steels. Replacing riveting by welding is urged for longitudinal, circular and end plate seams. EF (7c)

FINISHING (8)

H. S. RAWDON, SECTION EDITOR

Better Cleaning Equipment Aids in Application of Surface Coating. *Steel,* Vol. 94, Jan. 1, 1934, pages 133-134. Reviews 1933 developments in cleaning, pickling, and galvanizing. These include scale removal by high-pressure H_2O sprays; rubber-lined and brick-lined pickling equipment; addition of inhibitors to acid before shipment; wider use of liquid fluxes; improved coating technique; side firing of galvanizing pots; and use of temperature control instruments. MS (8)

Successful Finishing of Die Castings. Edgar Parkinson & Frank V. Faulhaber. *Iron Age,* Vol. 131, May 18, 1933, page 783, Adv. sec. page 14. Successful finishing of die castings is beset with many problems. In baking process, it is difficult to obtain good adherence of "finish." This may be due to composition of alloys, to smooth surfaces or to oil, grease or grime. Die-casting alloys are: (1) Sn-base alloys, composed of 60 to 80% Sn, 2 to 7% Cu and 3 to 7% Sb and small percent of Pb; (2) Pb-base alloys with 80 to 96% Pb, 4 to 20% Sb and sometimes as high as 10% Sn; (3) Zn-base alloys with 80 to 90% Zn and small amounts of Sn and Cu or Al and Cu; and (4) Al-base alloys with 90% Al with small percent of Cu, Ni and Si. The work should be perfectly clean before applying the "finish." Weak caustic solution may be used for cleaning castings if proper care is exercised. After cleaning, castings are heated to temperature at least 15°F. to 25°F. To expel gas in pores of metal Sn, Pb or Zn-base alloys should not be heated higher than 250°F. when baking. Composition of priming coat has considerable bearing on completed work. VSP (8)

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Pickling (8a)

The Pickling Tank of Tomorrow. J. R. Hoover. *Metals & Alloys,* Vol. 5, May 1934, pages 100-102. Development of Triflex rubber lining for pickling tanks is described. It consists of two soft and one hard rubber layers vulcanized into one sheath and is bonded to the steel shell tank by the special Vulcalock process. A specially jointed brick lining is then laid inside the Triflex. As much as 4 years steady service has been obtained from such equipment without the losses and annoyances attendant upon the use of the ordinary pickling acid containers. WLC (8a)

The Pickling of Iron and Steel and the Action of Inhibitors. Allan B. Dove. *Canadian Chemistry & Metallurgy,* Vol. 17, Sept. 1933, pages 192-194. Points discussed include: the theory of scale formation, acid brittleness, the theory of inhibitor action, physical factors in inhibition, the effects of pickling upon the parent metal and after-treatment of low-C steel. Conclusions drawn are: (1) scale does not consist solely of a single layer (Magnetic oxide) but rather of a triple complex construction (FeO, Fe_2O_3, and Fe_2O_3), (2) scale is removed in pickling mainly by solution of the FeO layer and dropping off of higher oxide layers, (3) pickling should be controlled chemically and thermally, (4) pickling influences the hardness of C steels, and (5) steels hardened and tempered within certain ranges of temperature may develop surface hardness and perhaps crack on deformation during later operations after pickling. WHB (8a)

Pickling Iron and Steel. William Ashcroft. *Metallurgia,* Vol. 9, Nov. 1933, pages 19-20. Some pointers on practice. JLG (8a)

Investigation on Inhibitors during Acid Pickling. Emilio Jimeno & Insidro Grifoll. *Anales de la sociedad española de física y química,* Vol. 31, July/Aug. 1933, pages 582-593. In Spanish. The factors contributing to corrosion are H formation and oxide solution. H liberation during pickling of Fe in H_2SO_4 at 72°C. was determined and the inhibitive action of various materials. Following order of merit was established: bone glue (best), soot, fish glue, Turkish red oil. aniline. linseed oil. tannin. starch. furfurol, mineral oil, p-toluidine, stearin, pyridine, Al-sulphate. At ordinary temperatures the order was as follows: Turkey red oil (best), bone glue, fish glue, soot, starch, furfurol, linseed oil, mineral oil, pyridine, stearin, p-toluidine, aniline. By proper selection of colloidal inhibitors, attack of the metal can be practically stopped. It appears essentially important that the additions are of a stable colloidal form. Oily substances are often effective inhibitors but their aqueous dispersions are unstable. EF (8a)

Investigations on Chlorate Pickling Solutions (Untersuchungen über Chloratbeizen) H. Krause. *Oberflächentechnik,* Vol. 11, Jan. 2, 1934, pages 1-4. See *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 143. Ha (8a)

Phosphoric Acid as Rust Removing and Rust Preventing Agent (Die Phosphorsäure als Entrostungs- und Rostschutzmittel) A. Foulon. *Maschinenschaden,* Vol. 10, 1933, pages 190-192. The beneficial effect of H_3PO_4 is based on (1) its ability to dissolve Fe oxides without attacking the basis metal, (2) the formation of phosphates insoluble in water. The phosphates adhere firmly to the metal and serve as a priming coat for paint and lacquer coatings. The Atrament process utilizes a primary metal phosphate and yields a fine crystalline film. A new feature of rust-removal by H_3PO_4, full details of which are given, is the addition of certain chemicals to retard rapid flowing off from vertical surfaces. EF (8a)

Cleaning, including Sand Blasting (8b)

Recovers Core Sand from Sand Blast. *Iron Age,* Vol. 131, June 15, 1933, page 943. Describes the removal of dust from sand blast in cleaning room of the Cleveland foundry of the Aluminum Co. of America. Dust collecting system is of a new type designed by the Dust Recovering and Conveying Co., Cleveland. VSP (8b)

Tube Wear by Gravel Blasting (Rohrangriff beim Kiesbläser) H. Quednau. *Die Wärme,* Vol. 57, Jan. 6, 1934, pages 8-11. The theory underlying the cleaning action of the gravel blasting machine ("Kiesweitstrahlbläser") is discussed mathematically and correlated with practical tests. Observations on boiler tubes during 3 years' service, revealed absence of any damage due to this cleaning method in contrast to the wear experienced with the conventional sand blasting process. Gravel of 3 to 4 mm. grain size is used under a pressure of 3 to 4 atm. EF (8b)

Increasing the Efficiency in the Foundry Cleaning Shop (Hebe die Wirtschaftlichkeit der Gussputzerei) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Mar. 4, 1934, pages 87-89. Stresses points to be observed in increasing efficiency in cleaning castings. Necessity of keeping tools and all equipment in proper condition is emphasized. GN (8b)

Polishing & Grinding (8c)

Gear Lapping after Heat-Treatment. R. S. Drummond. *Mechanical World & Engineering Record,* Vol. 94, July 21, 1933, pages 718-719; *Iron Age,* Vol. 132, July 6, 1933, pages 18-21. See *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 143. Kz + VSP (8c)

On the Electrical Nature of Iron Sparks Emitted from a Grinding Wheel. Ukitiro Nakaya. *Scientific Papers of the Institute of Physical & Chemical Research, Tokyo,* Vol. 23, Feb. 1934, pages 185-201. It is well known that the appearances of sparks emitted from an Fe tool while being sharpened on a grinding wheel are quite different for tools of various compositions. It is claimed that a well-trained artisan can identify the constituents of the tool material from the appearance of the sparks. Experiments with steel of varying C content and with W-Cr-V steels in air, CO_2 and O_2 were performed for "investigating the furious oxidation of Fe at high temperatures and the electrical nature of this spark particle." The curves of e/m show that a positive charge accumulates on the particle at the early stage, reaches a maximum value and then changes sign rather rapidly. The negative electricity thus obtained is again lost gradually. Further experiments are under way. 25 Figs. WH (8c)

Centreless Grinding. A. D. Meals. *Machinery,* London, Vol. 43, Jan. 4, 1934, pages 405-409. Deals with the increasing application of the process, with special reference to straight-through, bar and tube, in-feed and spherical grinding. Kz (8c)

Abrasives in Metal Polishes. C. S. Kimball. *Chemical Industries,* Vol. 34, Mar. 1934, pages 209-214. Discussion of composition and use of some commercial metal polishes. RAW (8c)

Grinding Machines in the Locomotive Shop. H. H. Asbridge. *Railway Engineer,* Vol. 54, Dec. 1933, pages 370-371. Importance of interchangeability and elimination of hand work in locomotive shop work are stressed. Following data illustrate the economy of grinding, the percentage reduction of cost shown being made on the comparative basis of up-to-date machine tools: regulator valves, 45%; axle journals, 6 per engine, 60%; slide bars, 4 per engine, 60%; axle box face supplements, 8 per engine, 65%; fitted bolts for horn-guide stays, 56 per engine, 50%. WH (8c)

Mechanical Finishing. Walter P. Barrows. *Metal Industry,* N. Y., Vol. 31, Aug. 1933, pages 273-276. From the *Review American Electroplaters' Society,* Apr. 1933. Practical experience in tumbling and burnishing is described. Water conditioning, soaps, steel balls, repair of barrels, etc., are mentioned. PRK (8c)

Gear Grinding. *Automobile Engineer,* Vol. 24, Jan. 1934, page 31. Trimming of wheels according to the British Standards Institute is described. Machine-cut gears should have a radius at the bottom of the tooth. Ha (8c)

Electroplating (8d)

A Further Study of Anodes for Zinc Plating. A. K. Graham, G. B. Hogaboom, Jr. & L. E. Graham. *Metal Industry,* N. Y., Vol. 31, June 1933, pages 195-197. Contains bibliography. Investigation of Al and/or Hg additions to Zn anodes revealed that a Zn anode containing 0.5% Al and 0.5% Hg is sludge-free and has a constant anode polarization at 2.9 volts in cold or warm cyanide baths at current densities as high as 30 amps. per $ft.^2$. Pure Zn and Hg-Zn anodes form sludge and have variable polarization upon intermittent plating. Roughness of the deposit varies with the sludging tendency of the anode. Cathode efficiency is unaffected by current density and temperature, and anode efficiency only slightly affected by temperature and anode composition, and slightly decreased by increasing current density. PRK (8d)

The Structure of the Cathodic Deposit (Über das Gefüge des kathodischen Niederschlages) A. Glazunov. *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 167, Jan. 1934, pages 399-406. The process of metallic deposition during electrolysis is characterized as a crystallization process whose crystallization nucleus and crystallization velocity functions are influenced by many more factors than in ordinary crystallization processes. These factors are dealt with summarily. Author introduces a method adapted for the measurement of the number of crystallization nuclei and the crystallization velocity of the metal deposited at the cathode. It has been found that the growth of the cathodic deposit follows the direction of the current flow and takes place perpendicularly to the lines of current flow. The former effect is larger than the latter. EF (8d)

Anodic Behavior of Nickel. III. (Das anodische Verhalten des Nickels) K. Georgi. *Zeitschrift für Elektrochemie,* Vol. 39, Sept. 1933, pages 736-743. The behavior of Ni as anode in an electric circuit is investigated in the light of Mueller's hypothesis that no metal emits ions until H_2O as dielectric has entered into the lattice structure at the more easily soluble places of the metal surface. Ni as anode in the solutions of oxygen acids at about + 1.5 volts assumes the capacity to retard, by quantitative Ni·· formation, a further increase of potential and becomes "anodically active." As, however, such potential is difficult to produce by chemical oxidation Ni remains almost insoluble; the very low rate of solubility due to the attack of the acid electrolyte can be represented by

$$\mathrm{Ni(OH)_3 + 3H' \longrightarrow Ni^{\cdots} + 3H_2O} \text{ and}$$
$$\mathrm{4Ni^{\cdots} + 4OH' \longrightarrow 4Ni^{\cdot\cdot} + 2H_2O + O_2}.$$

The influence of oxidizing agents on Ni can be considered to be the same for velocity of solubility and anodic polarization. The transition from the active state at the higher potential to the inactive state is due to the diffusion layer on the surface becoming poorer in H′. 8 references. Ha (8d)

Anodic Behavior of Iron (Ueber das anodische Verhalten des Eisens) K. Georgi. *Zeitschrift für Elektrochemie,* Vol. 39, Sept. 1933, pages 745-749. The influence of H-concentration on passivity of the Fe-metals consists in the dissolving of the natural oxide surface film, thus exposing a clean metal surface, according to the accepted theories of W. J. Mueller. However, on basis of experiments with Co and Ni it is probable that the anodic behavior of Fe is influenced directly by H in the process of solution, although less than Co and Ni. Ha (8d)

Polarographic Studies with the Dropping Mercury Cathode. Part XXXVII. **The Electrodeposition of Gold.** John Herman. *Collection of Czechoslovak Chemical Communications,* Vol. 6, Jan.-Feb. 1934, pages 37-53. In English. The electrodeposition of Au at the dropping Hg cathode has been investigated polarographically in solutions containing Au··· and Au· complexes with excess of alkali hydroxides or alkali cyanides. From the Au··· complexes Au deposits at a voltage by 0.7v. smaller than from the Au· complexes. The limiting current (height of wave) due to the electro-deposition of Au from Au· solutions is as high as that observed with Ag solutions of equivalent strength. It has been found that Au··· complexes are always accompanied by Au· complexes, into which they slowly decompose, but are in no mobile equilibrium. The form of the current-voltage curves indicates that after the addition of KCN to the Au $(OH)_3$-Au complex, an Au‴-OH-CN complex is formed, which when once formed, remains unaltered even in the presence of a large excess of alkali cyanide. The Al‴-CN-complex is, however, not transformable into the OH-CN complex by excess of KOH. When mixed, both sorts of complexes keep their individual properties, being not interchangeable. Methods are given by which Au might be polarographically estimated in ores and alloys. GTM (8d)

Supplement to the Paper "On the Size of Electrolytically Developed Gas Bubbles" (Nachtrag zu der Arbeit "Über die Grösse elektrolytisch entwickelter Gas blasen") B. Kabanow & A. Frumkin. *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 166, Sept. 1933, pages 316-317. Discussing the quantitative determination of the gas bubble size (See *Metals & Alloys,* Vol. 5, May 1934, page MA 205) based on evaluation of the contact angle, attention is called to a recent paper of Wark (See *Metals & Alloys,* Vol. 5, March 1934, page MA 114) who theoretically established the tenacity of adhesion of a gas bubble on a solid surface with reference to the flotation process. Disregarding a slight deviation in the case of Ag, an excellent agreement of the value experimentally determined on Pt and Hg (electrolytically developed, mechanically plated and platinized) and the theoretical curve of Wark is pointed out, showing that the size of the electrolytically evolved gas bubble depends solely on capillary forces and on the force of gravity. EF (8d)

Control of Chromium Plating Baths (Réglage pratique des Bains de Chromage à l'Atelier) J. Loiseau. *Usine,* Vol. 43, Mar. 15, 1934, page 27. By means of a little brass angle suspended in the bath the condition of the latter with respect to acidity is determined; 5 min. at 4 v. and 40 amp., conditions used. Bath conditions are judged from the deposit on this angle. Normal operation at about 40 C. requires a ratio of SO_4 to CrO_3 of about 100, while for bright deposits it varies between 50 to 200, according to temperature and current density applied. Ha (8d)

Measurement of "Throwing Power" of Electrolytic Baths (Ueber die Messung der Tiefenwirkung galvanischer Bäder) Fröhlich. *Mitteilungen des Forschungsinstituts und Probieramts für Edelmetalle,* Vol. 7, Mar. 1934, pages 149-152. The method of Onitchenko (see *Zeitschrift für Elektrochemie* 39, 815, 1933) to test the scattering effect or throwing power of an electrolytic bath by a little angular auxiliary anode is described. Data from these tests are reproduced in tables and permit one to determine for different current densities and temperatures the current efficiency and relative throwing power. Ha (8d)

Cast Iron Particularly Suited for Electrodeposition (Für galvanische Metallabscheidung besonders geeignetes Gusseisen) H. Reininger. *Metallwaren Industrie und Galvano-Technik,* Vol. 31, Sept. 1933, pages 359-361, pages 379-381, pages 419-421. Metallic coatings deposited on cast iron containing coarse graphite flakes are liable to be mechanically defective. The pearlitic matrix of cast iron should exhibit as little laminated graphite as possible. C and Si contents, besides Ni and Cr additions and cooling conditions influence the graphite distribution. Overheating and shaking of the melt promote a finer graphite distribution. Occasional oxide inclusions can be removed by certain melting procedure. EF (8d)

Deposition of Pink Gold. Alfred K. Pritchard. *Metal Industry,* N. Y., Vol. 31, Dec. 1933, page 408. A stock solution and plating conditions are described for obtaining pink gold deposits. Modifications of solution to obtain different shades are discussed. PRK (8d)

Rhodium Plating. Colin G. Fink & George C. Lombros. *Metal Industry,* N. Y., Vol. 31, June 1933, pages 208-209. See *Metals & Alloys,* Vol. 5, Feb. 1934, page MA 49. PRK (8d)

Tests of Thickness of Protective Cadmium Coatings on Steel. S. G. Clarke. *Metal Industry,* N. Y., Vol. 22, Nov. 1933, pages 373-374. See *Metals & Alloys,* Vol. 5, May 1934, page MA 204. PRK (8d)

Porosity in Cadmium Coatings on Steel. S. G. Clarke. *Metal Industry,* N. Y., Vol. 31, Sept. 1933, page 307. See "Detection and Significance of Porosity in Electrodeposited Cadmium Coatings on Steel," *Metals & Alloys,* Vol. 5, May 1934, page MA 205. PRK (8d)

Chromium Plating Literature, XXII, XXIII. L. H. Decke. *Platers' Guide,* Vol. 30, Feb. 1934, pages 13-14; Mar. 1934, pages 13-15. General references. WHB (8d)

A Progressive Plating Shop. Leonard F. Hirsch. *Metal Industry,* N. Y. Vol. 32, Mar. 1934, pages 92-93. A description of the Philadelphia Rust Proof Company, Pa., is given. PRK (8d)

Adherence of Electrolytic Deposits (Sur une Méthode de Mesure de l'Adhérence des Dépots Électrolytiques) P. Jacquet. *Comptes Rendus,* Vol. 198, Apr. 4, 1934, pages 1314-1315. Method of measurement applicable to thin coatings of few tenths of millimeters. Sheet samples prepared by adsorbed layer of colloid and electrolytic deposit. Balance is attached to edge of coating and readings in kgs. represent average weight at which detachment begins and ends. FHC (8d)

Rubber and Its Application to the Electro-Plating Industry. J. F. Amlicke. *Metal Industry,* N. Y., Vol. 32, Feb. 1934, pages 54-55. Generalization on the uses of rubber for equipment in electro-plating. PRK (8d)

Electroplating and Deposition of Metals. H. S. Bavister. *Institution of Production Engineers,* Vol. 12, Oct. 1933, pages 435-472. Includes discussion. Paper presented to the Institution of Production Engineers Luton, Bedford and district section. After dealing with principles of electrodeposition, author discusses plating solutions and their "throwing power." Plating practice, including polishing and cleaning, is discussed in detail. After cleaning with trichlorethylene, the work is treated in an electrocleaner, a very effective aqueous solution which consists of 2 oz. soda ash, 1 oz. caustic soda, and 2 oz. trisodium phosphate or 1 oz. either sodium silicate or sodium aluminate per gallon. Washing in water and dipping in various solutions, according to the metal treated, follows. Some preparatory operations necessary to Cr plating are critically discussed, and data on current density, temperature and different thicknesses of films required are given together with compositions of plating solutions. Besides Cu and Ni plating, the present practice of Cr plating is described in so far as it embodies the latest developments and technique. Troubles and their prevention, removal of faulty deposits, production of thick Cr deposits (approx. 0.001-0.010 in.) for resisting wear and abrasion are separately discussed. Solutions and various addition agents used in Cd plating solutions are discussed. Author says that the only addition agents for improving the brightness of deposits, shown to be safe by experience, are sodium thiosulphate to copper cyanide bath, cadmium sulphate or a Cd anode in Ni baths and glue, peptone, or oil of cloves in Pb solutions. Use of Cu plating as anti-carburizer is discussed. Kz (8d)

Getting Best Results from Chromium-Plated Cutting Tools. Chas. F. Bonnett. *Machinery,* N. Y., Vol. 40, Dec. 1933, pages 212-214. Cr-plating of turning and planing tools, drills, reamers and files improve cutting efficiency; best method of Cr plating is discussed for each kind of tool. Ha (8d)

Nickel-Chromium Plating Technique. Maurice Cook & B. J. R. Evans. *Metal Industry,* London, Vol. 44, Mar. 9, 1934, pages 279-281; Mar. 23, 1934, pages 329-331. The different stages of the process from preparing the work to finishing are described in detail. Ha (8d)

Measuring the Thickness of Electro-Plates. Fred Carl. *Metal Industry,* N. Y., Vol. 32, Mar. 1934, pages 95-96. From the *Monthly Review American Electro-Platers' Society,* Oct. 1933. The details of copper plating, mounting and polishing and etching are given for the microscopic examination of Cu and Ni on steel, Cu and Ni on brass, and Cu and Ni on Zn base die castings. To etch steel for contrast with nickel, either 5 vols. HNO_3 + 95 vols. alcohol or glycerine, concentrated HF, concentrated HNO_3, (in proportion 3, 2, 1) is used. PRK (8d)

Plating of Castings. B. Caplan. *Metal Industry,* London, Vol. 44, Mar. 23, 1934, pages 327-328. Common defects of castings and their preparation for plating are discussed; cleaning methods consist of sandblasting, alkaline solutions or anodic acid cleaning. Ni and Cr plating processes are briefly outlined. Ha (8d)

Chromium Plating of Surfaces (Verchromung von Oberflächen) G. Elssner. *Zeitschrift Verein deutscher Ingenieure,* Vol. 78, Mar. 31, 1934, pages 415-421. The economic importance of Cr-plating due to its hardness is pointed out and various industrial uses are reviewed. Scratch tests with a diamond under only 5 g. load gave the following comparative values for coatings of about 0.005 mm. in thickness, the scratch-width being measured under a microscope with a scale:

Deposited material	Width of scratch, divisions	Comparative hardness, 1200/divisions
Tin, from acid bath	60	20
Lead, from fluoboric bath	50	24
Silver, from cyanide bath	42	29
Cadmium, from glossy bath	40	30
Copper, from acid bath	35	34
Brass, from cyanide bath	35	34
Nickel, 1 amp./dm.^{2}, 36°C.	26	46
Nickel, 0.4 amp./dm.^{2}, 20°C.	17	71
Nickel, highly polished	13	92
Chromium	5-7	171-240

Hardness varies with conditions of deposition and with absorbed H. Coatings which have been heated give a wider scratch. The rather complicated chemical process of deposition is discussed and it is shown how scattering and "throwing power" can be improved by proper bath concentration; bath should contain 250-450 g. chromic acid per l. The content of H_2SO_4 is very important; highest current efficiency is obtained with 1.1% H_2SO_4, referred to chromic acid dissolved in one l; with less than 0.4% or more than 2% the current efficiency is practically nil. Influence of bath temperature and current density on the deposit, and the different methods with and without intermediary layers are discussed; Ni is most used, and if more layers are employed Ni should be immediately under Cr. Alpaca (Cu-Ni-Zn alloy) and tombac (Cu-Zn alloy) can be plated directly. Various fields of application are described. 7 references. Ha (8d)

Cadmium Plating of Iron and Steel Parts (Die Verkadmierung von Eisen- und Stahlteilen) Werner Fröhlich. *Die Metallbörse,* Vol. 23, Nov. 11, 1933, pages 1437-1438; Nov. 18, 1933, pages 1470-1471; Dec. 2, 1933, pages 1537-1538. An oxide film forms on metallic Cd and protects it in dry atmospheres against further oxidation. The film adherence is poor and Cd stands up worse than Zn. Due to the lower potential difference between Cd and Fe as compared with Zn and Fe, the anodic protection of Cd is not so pronounced as that of Zn, although it is satisfactory, a reasonably low porosity of the deposit being presumed. Fresh Cd plating solutions sometimes yield porous coatings. The addition of a small quantity of a used electrolyte is said to improve a fresh one. In absence of rain, a coating of 0.005 mm. yields satisfactory service and a deposit of 0.01 mm. protects steel parts against corrosion for years even under unfavorable conditions. Hot-dipped Cd coatings are not advisable for several reasons. A standard Cd plating solution comprises: 40-85 g./l. Na-Cd cyanide, 40-80 g./l. NaCN, 20-40 g./l. NaOH, 35-70 g./l. Na_2SO_4. NaCN is added to check anodic polarization. There should be 3-4 mol. NaCN per 1 mol. $NaCd(CN)_3$. The NaOH content compensates for the loss of cathodic current density due to the presence of NaCN. The beneficial effect of Na_2SO_4 has not been fully explained. Addition of 1 to 1.5 g. $NiSO_4$/l. yields bright and ductile coatings of higher corrosion resistance. Amounts as low as 0.3 g./l. are effective although Ni does not enter the deposit. Organic additions are Turkey red oil and gulak (12 g./l.). Voltage = 4-6 volts, current density = 3-3.5 amps./dm.^{2}, ratio of anode : cathode area = 1.5 : 1. Food containers should not be Cd plated. EF (8d)

Hydrogen Content and Hardness of Electrolytic Chromium (Sur la teneur en hydrogéne et la dureté du chrome électrolytique) Guichard, Clausmann, Billon & Lanthony. *Comptes Rendus,* Vol. 196, May 29, 1933, pages 1660-1663. With a view to extending their observations on the relationship between the hydrogen content and hardness of various metals, the authors studied electrolytic chromium prepared by electrolysis of a solution containing 240 g./l. of chromic acid and 6.2 g./l. of violet chromium sulphate, with a Pb anode and a Cu cathode partly coated with paraffin so that one face only was exposed for the deposition of Cr. The cathode current density was 26 amps./dcm.^{2} with a p.d. of 4.8 v. Plates or disks analyzing 99.5% Cr, and weighing about 20 g., were produced. Fractional extraction of H was carried out in vacuum, variations in the indentation hardness of the metal were measured by means of a 1-mm. ball and a 10-kg. load applied for ½ minute. Complete extraction of H was found particularly difficult, it being necessary to heat the samples for a number of days to arrive at the limit of extraction corresponding to each temperature. A diagram shows the relationship between H content, hardness, and time of annealing in days, for two samples. Removal of H was very marked at low temperatures. It slowed up considerably with increasing temperature and terminated at about 500° C. For one sample, hardness did not decrease rapidly until about 380° C. when 96% of the H had been eliminated. For another sample, hardness began to decrease at a little above 300° C.; at 320° C. when 95% of its H had been eliminated, it hardness number was 463, equal to the initial hardness of the first sample. Although this sample gave no more H above 485° C., its hardness number was still quite high, and was reduced by heating at increasing temperatures to 168. The results obtained with Cr are not so readily explained as those obtained with iron. However, the explanation which has hitherto been given by the authors, without reserve, for iron applies in the case of Cr. H is not responsible for the remarkable hardness of electrolytic metal; it is explained by the structure of these metals, which corresponds closely to that of cold-worked materials. OWE (8d)

Metallic Coatings other than Electroplating (8e)

Metallization of Tubes (Zur Frage der Metallisierung von Röhren) W. G. Reene. *Die Metallbörse,* Vol. 23, Nov. 18, 1933, page 1471; Nov. 25, 1933, pages 1502-1503. Brief review of the history of metal spraying and the more recent utilization of providing tubes with protective coatings. Welded joints in galvanized tubes buried in the soil have been shown to be stable against corrosion if no eddy currents are present. EF (8e)

Study of the Tin Coating on Tin Plate (Die Untersuchung des Tinnüberzuges von Weissblechen) F. Eisenkolb. *Stahl und Eisen,* Vol. 54, Feb. 1, 1934, pages 109-110. Analytical methods are described for determining weight of the tin coating and of the lead content of the tin. The use of ferricyanide-gelatine solution for detecting pin holes gave less scatter and proved simpler than immersion in hot water. Scratching of surface after tinning was found an important cause of pin holes. SE (8e)

Report of Subcommittee VIII on Field Tests of Metallic Coatings (Report of Committee A-5 on Corrosion of Iron & Steel) R. F. Passano, Chairman. *Proceedings American Society Testing Materials,* Vol. 33 Pt. I, 1933, pages 149-165. Progress of field tests at Pittsburgh, Pa., Altoona, Pa., State College, Pa., Sandy Hook, N. J., and Key West, Fla., on hardware, structural shapes, tubular goods, etc. permit the following summary. Resistance to corrosion of zinc coatings depends substantially on the weight of coating and not on the process by which coatings were applied. Electrodeposited coatings (whether of zinc or cadmium) are thinner in recessed parts than on regular sections and non-recessed areas. Consequently, coatings fail first in the recessed portions of test specimen. Hot-dipped aluminum coatings (which are usually heavy coatings) have given good protection at all locations. These coatings on samples under test are distinctly rough and it was necessary to recut threads on aluminum-coated nipples and ells in assembling them. At Key West, Sandy Hook, and State College it is evident that lead coatings do not prevent rusting of the base metal which is exposed at pinholes, as well as do zinc and cadmium coatings. At industrial locations, Altoona and Brunot Island (Pittsburgh), where zinc and cadmium are rapidly weathered away, lead is sufficiently resistant to offer considerable protection to the underlying iron or steel. At no location have Parkerized and oiled finishes been found to afford suitable protection for outdoor service. Articles, Parkerized and subsequently painted or enameled, have not been tested. Following tentative conclusions apply to electrodeposited nickel and chromium coatings. Protective value is determined principally by the total thickness of the nickel or of nickel and copper. Coatings with total thickness of less than 0.0005 in. have little protective value, whereas those with 0.002 in. are nearly perfect after a year's exposure. The presence of a copper layer reduces the protective value of a coating of a given total thickness. Very thin chromium coatings reduce the protective value of relatively thin deposits of nickel or of copper plus nickel, while thicker coatings of chromium furnish added protection. A sufficiently heavy coating of nickel will minimize the effect of a copper layer next to the steel if final chromium finish is approximately 0.00003 in. or more in thickness. VVK (8e)

Application of Aluminum to Reaction Chambers Prevents Metal Loss. H. R. Leland. *National Petroleum News,* Vol. 26, Apr. 11, 1934, pages 25-26. A coating of Al sprayed on interior parts of a Dubbs reaction chamber held at relatively high temperature and pressure protected the dome against corrosion by H_2S vapors. (8e)

Metal Spraying. W. E. Ballard. *Sheet Metal Industries,* Vol. 7, Dec. 1933, pages 479-480; Vol. 8, Jan. 1934, pages 43-44; Feb. 1934, page 124. See *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 144. AWM (8e)

Surface Protection Leonard F. Hirsch. *Product Engineering,* Vol. 5, Apr. 1934, pages 135-137. Durability, economy and appearance of hot-galvanized, sherardized, zinc-plated, cadmium-plated, parkerized and bonderized surfaces are compared. Methods of application, advantages and limitations are compiled in a table. Ha (8e)

Practical Experiences in Vessel Construction for the Refrigeration Industry with Particular Reference to Welding and Galvanizing (Praktische Erfahrungen im Behälterbau für die Kälteindustrie unter besonderer Berücksichtigung von Schweissung und Verzinkung) A. Besag. *Zeitschrift für die gesamte Kälteindustrie,* Vol. 40, Mar. 1933, pages 42-46; Apr. 1933, pages 56-57. Lecture before the Berliner Kälteverein. Discusses structural features and utilization of gas and electric welding for construction of containers in refrigeration industry. The preliminary handling of the materials and the process of galvanizing are fully considered. Zn spraying is considered to be inferior to hot galvanizing because of a more porous coating. The addition of Al as 90/10 Zn-Al alloy to the galvanizing bath is recommended. EF (8e)

Avoidance of Stains and Stripes in Tinning (Wie vermeidet man die Flecken und Streifenbildung beim Verzinnen?) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Mar. 4, 1934, pages 95-96. Discusses chemical causes of stains on tinned Cu parts. In order to obtain a porefree pure Sn coating on Cu careful preliminary surface preparation and careful procedure in tinning is absolutely necessary. Since Cu dissolves freely in Sn, Sn baths must be purified frequently. Disadvantages of tinning by wiping Sn on surface are: wiping process itself, non-uniform temperature, Sn coating becomes the poorer the more surface is wiped. Besides direct chemical causes of staining mentioned some indirect causes that intensify stains are mentioned. Improper porous Sn coating may result from careless pickling. The better the pickling, the more easily tinning is accomplished. GN (8e)

New Tinplate Invention *Tin,* Mar. 1934, pages 15-16. A weighing and sorting machine is briefly described (without details) which weighs and sorts sheets into 3 staples of under-normal, normal and over-normal weight; it is mounted directly to the sheet cleaning machine and requires 1/6 H.P. for driving. In the tinplate industry of Wales it replaces manual sorting. Ha (8e)

Surface Treatment of Aluminum. *Mechanical World & Engineering Record,* Vol. 94, Nov. 3, 1933, pages 1056-1057. Discussion of process by which sheets, castings, etc. could be given in 3 to 5 min. a protective coating claimed to make them fully inert to action by salt water and other chemical agents. The coating can be reinforced by further impregnation. In cases where hot solution can not be used, a paste may be applied at ordinary temperatures to obtain a coating as efficient as the hot bath coating. The bath is an aqueous solution of anhydrous sodium carbonate (5%) and anhydrous sodium chromate (1.5%) used at 90-100° C. Treatment tanks should be wood, welded sheet iron, or enamelled material. The composition of the paste is as follows:

Sodium chromate	10 parts
Anhydrous sodium carbonate	4 parts
Caustic Soda	4 parts
Water	10-15 parts

The paste is applied with a brush, and is removed by rinse in water after 10-15 minutes. Kz (8e)

Metallisation: The Deposition of Metallic Coatings by Spraying. *Mechanical World & Engineering Record,* Vol. 95, Mar. 2, 1934, pages 210-211. Metallisation is a process by which molten metal is sprayed by a blast of compressed air at high speed on to the surface to be coated. The spray is cool enough to cause no discomfort to the hand if inserted in it. No detrimental effect results in coating heat-treated or high-tensile steels as no heating takes place. The preliminary cleaning for metals is sandblasting, hence acids or other corrosive media are not encountered. The metal to be deposited in form of wire, is fed into a special pistol (details given in drawing) where it is melted in a gas flame. Compressed air provides the dispersive and propelling effect. It is applicable to metals, wood, fabric, celluloid. The combustible gas may be hydrogen, coal-gas, or acetylene. Coal-gas, compressed by a small compressor to 25 lbs./in.^{2}, is cheapest for most uses. Kz (8e)

Aluminum Powder and Aluminum Paints (Aluminiumpulvèr und Aluminiumfarben) FRANZ FRIEDRICH. *Die Metallbörse,* Vol 24, Feb. 7, 1934, pages 162-163; Feb. 14, 1934, pages 194-195. A high grade of Al is required for corrosion inhibiting Al paints. Fe and Si deleteriously affect the silver white color and render the metal brittle; they cause difficulties in the manufacture of the powder due to Fe oxidation and resulting temperature increase. Erroneous instructions in literature statements for making Al powder are criticized. Hammering and crushing on steel anvils, in mortars, etc., after annealing treatments are advised. Coagulation of the minute particles is prevented by addition of stearic acid, olive oil, mineral oils, etc. The Al powder is finally polished in drums provided with rotating brushes. According to the luster desired, different lubrication means are employed. Recipes for making Al paints are given. In contrast to many otherwise valuable paint coatings, Al paint is effective in atmospheres containing H_2S and SO_2. The stability at elevated temperatures (up to 450°C.) is emphasized as well as the poor resistance to alkaline attacks (mortar, cement, concrete). Al paints are advantageously utilized as outer coat on top of read lead, bitumen, lead white. Further uses of Al powder are discussed. EF (8e)

Non-Metallic Coatings (8f)

Corrosion Resistance of Varnished Metal Surfaces (Die Korrosionsbeständigkeit lackierter Metalloberflächen) *Aluminum,* Vol. 16, Mar. 15, 1934, pages 3-4. Fe is attacked by acidic oils, but very little by basic oils or fats. Cu and brass are more attacked by basic oils, Al is much less sensitive against acidic oils but even weakly basic oils destroy the surface quickly. Lacquers have been proved best for Cu, brass and Al. They must be carefully composed, best results have been obtained with copal lacs. Brazil copal is the least satisfactory, Zanzibar copal the best. Before applying the lacquer coating the surface must be thoroughly cleaned of every trace of acid and humidity. Ha (8f)

Cadillac Now Lacquers Rustproofed Sheet Metal Parts in Matched Sets. *Automotive Industries,* Vol. 69, Oct. 7, 1933, page 433. Two important changes in fender finishing have been adopted by Cadillac in new models, (a) change from enamel to Duco Lacquer, and (b) bonderizing in the finishing line. Sheet metal parts are matched in sets to insure correct color combinations. DTR (8f)

Anodic Treatment and Dyeing of Aluminum Castings. N. D. PULLEN. *Mechanical World & Engineering Record,* Vol. 93, July 14, 1933, pages 668-669; *Foundry Trade Journal,* Vol. 48, June 22, 1933, pages 423-424. See *Metals & Alloys,* Vol. 5, Mar. 1934, page MA 105. OWE+Kz (8f)

Conveyors Speed Up Enameling of Stove Parts. J. B. NEALEY. *Steel,* Vol. 92, June 26, 1933, pages 25-27. Describes equipment and practice of the new enameling division of the Florence Stove Co., Kankakee, Ill. MS (8f)

The Bonderizing Method (Das Bonderverfahren) FR. KOLKE. *Metallwaren Industrie & Galvano Technik,* Vol. 31, Aug. 1, 1933, pages 285-296. Bonderizing aims to form a phosphate film on Fe by use of $MnPO_4$ in the presence of a Cu salt, at 98°C. The film serves as a better primer for subsequent paint coatings. The method is briefly compared with the similar Atrament and Parker process. EF (8f)

The Technique of Parkerizing and Bonderizing (La Tecnica della Parkerizzazione e Bonderizzazione) O. MACCHIA, F. MORENO & G. ODDONE. *L'Industria Meccanica,* Vol. 15, Nov. 1933, pages 866-868; Dec. 1933, pages 932-933; Vol. 16, Jan. 1934, pages 24-26. Principles of methods, preparation of pieces and processes are described. Illustrations are given; cost of these processes in Italy compares favorably with other methods of protecting iron and steel. Ha(8f)

Paint Coatings on Copper, Discoloration by Copper and Utilization of Copper Powder in Paints (Anstrich von Kupfer, Fleckenbildung durch Kupfer und Verwendung von Kupferpulver in Anstrichfarben) H. A. GARDNER & L. P. HART. *Farben Zeitung,* Vol. 38, Aug. 5, 1933, pages 1243-1244. Painted Cu samples were scratched and exposed to atmosphere for 4 months. Coatings of white linseed oil paint and quickly drying fatty-oil lacquer paints stayed intact in contrast to enamel coatings involving thin lacquers. This is ascribed to the large thermal expansion of Cu. Discoloration of painted surfaces by Cu and bronze is checked by fatty lacquer or oil varnish paints on the Cu. Metallic Cu paint on steel is decidedly detrimental due to resulting electrolytic effects. Al bronze and Zn dust gave relatively favorable protection under the same testing conditions. EF (8f)

Some Fusion Properties of Ground Coat Enamels as Influenced by Composition. W. N. HARRISON & B. J. SWEO. *Bureau of Standards Journal of Research,* Vol. 10, Feb. 1933, pages 189-209. Compositions of 9 vitreous ground coat enamels for sheet iron were varied within a region approximating commercial practice by substituting silica (added as flint) for feldspar, and boric oxide for sodium oxide, and vice versa. In 2 other enamels the same fluxes were varied as a unit against the refractories as a unit. Fusion properties of the enamels were studied through determinations of (1) temperature of maximum heat absorption, (2) softening temperatures as observed with the interferometer, (3) cone deformation temperature, (4) "button" deformation behavior, and (5) fusion block deformation behavior. The conclusions were: (1) Increasing silica at the expense of feldspar increased the refractoriness moderately and approximately uniformly. (2) Increasing boric oxide at the expense of sodium oxide caused an increase in refractoriness which varied with the percentages of these constituents which was quite marked when the boric oxide content was near its minimum and the sodium oxide content near its maximum, but which diminished progressively as the opposite limits were approached. (3) The extent of this variation was different for different tests, and diminished as the amount of flow required to complete the respective tests increased which was probably due to the fact that differences in viscosity of the enamels had more opportunity to influence the results of those tests which involved a greater flow of the specimens. (4) The mean end temperatures of the various tests increased as the amount of flow required to complete the tests increased. (5) More systematic comparisons of enamels could be made by measuring the heat treatment necessary to produce a given effect than by submitting all samples to the same treatment and distinguishing between them by the varying effect produced. (6) Application of the enamels to test pieces under varying conditions indicated that all of the tests placed them in approximately the correct order of fusibility. WAT (8f)

Dyeing Gives Aluminum a Color Finish. *Iron Age,* Vol. 131, Mar. 2, 1933, page 357, adv. sec. page 18. Describes a process known as Alumilite, licensed by Aluminum Colors, Inc., Indianapolis. The process is exclusively for Al and its alloys. Basically, the dyeing process depends upon the anodizing process. The product is electrolytically oxidized by being made the anode in a suitable electrolyte. It is next transferred to a vat of dye which penetrates the oxidized surface layer to depths varying from 0.0003" to 0.001" after which it may be polished. Resists ordinary acids. The process is not recommended for cooking utensils. VSP (8f)

Corrosion Protection of Iron Structures (Über den Rostschutz von Eisenkonstruktionen) J. G. VEAR. *Farbenzeitung,* Vol. 38, Oct. 7, 1933, pages 1470-1471. The most pronounced corrosion occurs on the comparatively sharp edges of girders, plates, nuts, bolt and rivet seats mostly due to weakness in the paint film. Next the surface condition of a structure before painting is of paramount importance. Removal of moisture, rust and mill scale is indispensable. Painting in the workshop is preferable to erecting unpainted sections allowing them to weather and subsequently peeling off of the mill scale. Priming paints and their application stand next in order of importance. Red lead in linseed oil offers a hard and rather elastic film. Priming with boiled oil or a bituminous solution is of rather doubtful value. The value of graphite as a primer is still debatable. Primers should be allowed to dry fully and harden thoroughly. The finishing coat should be pigmented, the pigment being fine and even in texture and capable of readily mixing with an oil vehicle. Additions of oil varnishes proved to be particularly suitable. Graphite as a pigment offers strong resistance and remains in good condition for many years. Bituminous solutions containing tar products appeared to give fairly reliable results. EF (8f)

Serviceability of Bituminous Paint Coatings (Bewährung von Bitumen Anstrichfarben) A. W. RICK. *Farbe & Lack,* June 14, 1933, pages 283-284. The protective action of bituminous coatings is of a passive nature and exclusively to be ascribed to the hermetical sealing of the underlying metal and prevention of access of all deteriorating agents. The use of corrosion inhibiting agents such as red lead is unnecessary. However a combination of a red lead-oil primer + a bituminous upper coat proved useful. Besides bituminous coatings containing black pigments, (soot, graphite, Fe-oxide black, micaceous Fe-oxide ore) colored ones have been secured by adding Fe-oxide red, Fe-oxide yellow, Cr-oxide green, Ti-dioxide and Ti-white. Al powder is used in heat-insulating coatings. Difficulties encountered with bituminous coating materials are discussed criticially. EF (8f)

Temperature Effect of Various Colored Tank Coatings (Der Temperatureffekt verschiedener Tankanstriche) L. R. MOSES. *Farbenzeitung,* Vol. 38, Nov. 11, 1933, page 1612. Experiments on (1) white synthetic resin, (2) Al lacquer and (3) black graphite paint coatings applied to water-filled tanks and gasoline cans showed that a white coating, if it preserved its color, had a heat insulation superior to a black coating and to Al paint coatings. In summer the temperature of the tanks coated with (1) was 2° lower than in the case of Al coatings and about 4° lower than with (3). The temperature drop during the night was larger in a container provided with a black coating such as (3). Vessels painted with white coatings showed a lower temperature gradient between liquid and atmosphere and cooled off more slowly. The reflectivity of the 3 coatings was not affected by size and shape of the containers nor by the nature of their liquid content. EF (8f)

Seawater Resistant Coatings (Seewasserbeständige Anstriche) DAMM. *Farbe & Lack,* May 1933, page 260. Discusses seawater resistance of nitrocellulose and cellulose paint coatings and gives recipes. EF (8f)

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Hard Rubber as Corrosion Protection (Hartkauschuk [Hartgummi] als Korrosionschutz) Fritz Ohl. *Die Metallbörse,* Vol. 24, Jan. 31, 1934, pages 129-130. Pure hard rubber ($C_{10}H_{16}S_2$) should render satisfactory service from the chemical standpoint. To overcome differences in the thermal expansion of the basis metal and the coating, inert fillers are employed, mainly barite, pumice stone, diatomaceous earth, etc. Solid hard rubber can be used to 80° C., with short-time heating to 100°-130° C. as the maximum. List of chemical reagents which rubber coatings withstand is given and a compilation of data (3 tables) on electrical and physical properties of different rust inhibitive rubber coatings on the market. EF (8f)

Rust Protective Paints (Rostschutzmittel) Fritz Ohl. *Die Metallbörse,* Vol. 24, Feb. 21, 1934, pages 226-227. Reviews the anti-rust paints as follows: Oil paints + Zn, Pb, and Fe pigments and red lead grounding, oil paints + micaceous Fe, bituminous coatings on solvent and emulsion base, asphaltum and tar coatings, colloidal metal (Pb, Cr)-oil dispersions, cellulose lacquers, artificial resin and cork paints. In addition to remarkable corrosion resistance, the latter offers sound, heat and moisture insulation. The underlying chemical and physical factors insuring rust protection are pointed out. EF (8f)

Bituminous Paint Coatings for Light Metals (Bitumenfarben für Leichtmetalle) M. A. Pignot. *Farben Zeitung,* Vol. 38, Aug. 12, 1933, page 1270; *Oil & Colour Trade Journal,* Vol. 83, June 30, 1933, page 1731. Tests on light metals coated with the following: (1) 65% coal tar pitch, 5% phenol, 30% benzene; (2) 65% pitch, 5% pyridine, 30% benzene; (3) 65% pitch, 10% anthracene oil, 25% benzene. (1) and (2) dried reasonably quickly. After 2 months' exposure in seawater, coatings and carrier were unchanged and no cracking occurred after 2 hrs. at 70° C. When used as cathode in a cell, the following periods elapsed until a current, under an applied e.m.f. of 2 v., passed through the coating: nitrocellulose varnish, 5 min. to 6 hours; coal tar paints, 48 to 60 hours; pigmented varnish, 1 to 6 hours; heavily bodied oil, 100 hours. Coatings of heavily bodied oil + tar paint preserved an intimate bond whereas others flaked. Utilization of phenol in coal tar paints offers advantages. However paint coatings containing phenol attack underground Pb cables. In this case, pyridine or anthracene carefully freed from phenols should be used. EF (8f)

Swelling of Rust Protection Paints in Water (Über die Wasserquellung von Rostschutzfarben) Fritz-Jürgen Peters. *Farbenzeitung,* Vol. 38, Nov. 11, 1933, pages 1609-1611; Nov. 18, 1933, pages 1633-1635; Nov. 25, 1933, pages 1658-1659. Reports on extensive tests at the Chemisch-Technische Reichsanstalt, Berlin. Rust inhibitive coatings such as red lead, white lead, Fe-oxide red, Al bronze, as upper and under coats and in combination, were kept wet and the degree of soaking determined by weighing after increasing lengths of time. The 3 articles report on (a) water absorption of anti-rust paintings in relation to the coating thickness, (b) effect of drying time on the water absorption of oil paint coatings during continuous wetting, (c) behavior of coatings low in fatty oil during long-time soaking. Fe and glass were used as the paint carriers. Test results are presented in graphical form. The inferior rust protection of coatings low in fatty oils against water has little to do with their lack of swelling. The water absorption power is no criterion for evaluating a rust inhibitive coating but is a property which should be evaluated in connection with the study of other properties (elasticity). EF (8f)

Water Swelling of Rust Protection Paints (Über die Wasserquellung von Rostschutzfarben) Hans Hebberling. *Farben Zeitung,* Vol. 39, Jan. 13, 1934, page 41. In commenting on the above the author points out that W. Mühlberg (Dissertation, University of Leipzig, 1932) arrived at the same conclusion by an indirect method, i.e., by measurements of the electric resistance changes of coated electrodes. He found that the embedding of finely distributed mineral matter (pigments, filling materials) in a linseed oil film increases the resistance towards swelling and concluded that basic Pb-pigments surpass all inert additions in the stabilizing of varnish coats. EF (8f)

Experiences of the German State Railroad in the Fields of Corrosion Protection by Paint Coatings (Erfahrungen der deutschen Reichsbahn auf dem Gebiete des Korrosionsschutzes durch Anstriche) O. Lindemayer. *Farben Zeitung,* Vol. 38, Oct. 14, 1933, pages 1497-1498. See "Experiments and Success of the German State Railways in Protection Against Corrosion by Painting." *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 144. EF (8f)

The Manufacture of Porcelain or Vitreous Enamel on Sheet Iron. Glenn A. Hutt. *Metal Industry,* N. Y., Vol. 31, Oct. 1933, pages 338-340. From a paper read before the Anderson Branch of American Electroplaters' Society, Mar. 1933. Details, including chemical composition of materials used, temperature of baking, etc., are given of processes used in manufacture of porcelain enamels on Armco iron. PRK (8f)

Paint Coatings on Elektron (Über Anstrichfarben auf Elektron) Fr. Kolke. *Farben Zeitung,* Vol. 38, Dec. 23, 1933, page 1756. Tabulates test results obtained with various coatings on 2 Mg alloys after 6 and 18 months outdoor exposure. The greatest stability was secured with coatings whose primer had been stoved and which was insoluble and did not tend to swell. Alloys treated with bichromate solutions prior to painting were improved in their corrosion resistance. However, films produced by bichromate were not in general the equivalent of 1 or 2 additional layers of coating. EF (8f)

Friction Coefficient Tests on Cast Iron Distribution Mains with Centrifugally Applied Bitumastic Enamel Lining. Elson T. Killam. *Journal American Water Works Association,* Vol. 24, Oct. 1932, pages 1590-1608. A test of about four miles of centrifugally applied bitumastic enamel lined pipe in a new distribution system gave a Williams-Hazen coefficient of C = 150. VVK (8f)

Friction Losses in Thirty-Inch Steel Pipe Lined with Bitumastic Enamel. Farley Gannett & J. D. Carpenter. *Journal American Water Works Association,* Vol. 26, Jan. 1934, pages 1-11. Description of a 30-inch steel pipe line, 10 miles long, lined with Bitumastic Enamel. A Williams-Hazen coefficient "C" of 143.5 to 145.6 was obtained. VVK (8f)

Brown-Dyeing of Copper and Copper Alloys (Braunfärbeverfahren für Kupferlegierungen) H. Krause. *Mitteilungen des Forschungsinstituts und Probieramts für Edelmetalle,* Vol. 7, Mar. 1934, pages 141-147. Several solutions, copper sulphate, copper acetate, potassium-aluminum sulphate, ammonium chloride, ammonium sulphate, ammonium-acetate, sodium acetate, oxalate and tartrate were investigated for their suitability for coloring Cu and Cu alloys brown. Only a few gave satisfactory results; 50-60 g. $CuSO_4$ in 1 l. H_2O is recommended. In general, these solutions can be used in the place of the usual permanganate and chlorate treatment only when olive-brown or olive-green tints are desired, or reddish tints on Sn-bronze. Ha (8f)

New Finishes for Metals. C. R. Bragdon. *Metal Industry,* N. Y., Vol. 31, Sept. 1933, pages 305-306. Discussion of the application of synthetic materials to the needs of metal finishing trades. Special mention made of the phenol-formaldehyde type, which resists high humidity, alkalis and acids, but not sunlight, and of the alkalis or glycerol-phthalate type, which swells under conditions of high humidity. PRK (8f)

The Protal Process for the Protection of Light Alloys. J. Cournot. *Journal Society Chemical Industry,* Vol. 52, Nov. 3, 1933, pages 891-892. The Protal process is based on the following principle: If a strip of aluminum is immersed in a solution of an alkaline salt of a metal capable of forming two oxides, of which only the higher oxide is soluble in alkali, the nascent hydrogen produced by the action of the alkaline solution on the aluminum reduces the soluble oxide to the lower insoluble one. The latter will adhere tenaciously to the surface of the metallic strip. Practically, the object to be Protalized is immersed for about 40 minutes in a hot solution of the salts (composition not stated); there is a liberation of gas which ceases when the process is completed. The object is then rinsed and the protective film impregnated with an appropriate finish. VVK (8f)

Lacquers for Food Cans (Konservendosenlacke) G. Cadbury. *Farben Zeitung,* Vol. 38, Dec. 23, 1933, page 1785, Vol. 39, Feb. 17, 1934, page 172. **Canning Fruit and Vegetables.** G. Cadbury. *Journal of the Society of Chemical Industries,* Vol. 52, Nov. 3, 1933, pages 885-891. Paper before the Chemical Engineering Group, Oct. 1933, stresses importance of fact that Sn plating should be as perfect as possible so as to cover the whole of the steel. An additional double layer of baked lacquer, which is impervious to the action of fruit acids, gives a further protection. In ordinary unlacquered cans these fruit acids slowly act on the Sn and, if there are pin holes, more quickly on the exposed steel. H_2 is evolved and the Sn is dissolved by the acid. Stamping lids by impressing code marks has been given up since the lacquer invariably cracks at the edges of the stamped marks. A curious phenomenon discovered is that single lacquering is less effective than no lacquer, the defects being more pronounced with single lacquering. The chemical action seems to be concentrated on exposed parts, with the result that the Sn is destroyed more rapidly and the steel more quickly exposed. The making of fruit cans, canning processes and problems of fruit canning are exhaustively treated. EF (8f)

Protective Paints for Metals (Zur Kenntnis der Rostschutzfarben) U. R. Evans & S. C. Britton. *Farbenzeitung,* Vol. 38, Nov. 18, 1933, pages 1635-1636; *Chemical Trade Journal & Chemical Engineer,* Vol. 93, Oct. 27, 1933, pages 299-300. Reviews paper before the general meeting of the American Electrochemical Society, Chicago, Sept. 1933. For service in dry climates, the drier should be reduced to the minimum, but for wet climates or doubtful weather it should be added freely. No paint failure due to frost has been found. Superiority of Cu-bearing steel over ordinary steel has been confirmed. Good behavior of wrought Fe is pointed out. Effect of mill scale on the behavior of paint varies enormously with the type of scale. The lower scale on wrought Fe can be left in position. Descaling by pickling as a cause of premature failure has not been confirmed in contrast to invisible moisture films present on bright steel when painted before dawn. A good combination consists of red lead for the lowest coat and Fe oxide for the upper coats. Although otherwise excellent, chromates may fail when the rain is acid. Graphite is valuable in the outer coats but stimulates corrosion electro-chemically in the lower ones. EF (8f)

Some Notes on Vitreous Enamels and Colours. A. England. *Sheet Metal Industries,* Vol. 8, Feb. 1934, pages 125-126. The three essentials to be considered in building up an enamel formula are: (1) melting temperature of the finished enamel; (2) expansion of the enamel, which must closely approximate that of the basis metal; and (3) elasticity of the enamel, which must be such that it does not easily chip. Methods of meeting these requirements are discussed briefly. AWM (8f)

Progress in Painting Aluminum and Aluminum Alloys (Fortschritte im Anstrich von Aluminium und Aluminiumlegierungen) Eckert. *Paper Third Corrosion Congress Verein deutscher Ingenieure, Verein deutscher Eisenhüttenleute, Deutsche Gesellschaft für Metallkunde and Verein deutscher Chemiker,* Nov. 14, 1933, Berlin. Mimeographed report page 6. One of the most important conditions for attaining good and tightly adhering coats on Al and its alloys is proper pretreatment of surface. The adherence of otherwise intact paint layers is influenced by the formation of pores within the paint. This may have various causes that are discussed. Such pores are of submicroscopical size but can be detected by electrical methods. Pore-formation can be prevented by proper choice of pigments and proper ratio of diluting media to the pigment. Increased number of coats is not always successful for preventing pores. Former opinion that basic pigments are unfit must be revised. However, they cannot be worked with any random binding medium. An excellent pigment is very fine Al dust. Transformation products formed during drying process may be most injurious to material to be protected. A remedy is to remove these decomposition products which are mostly of acid nature by heating (burnt lacquers). Various synthetic products gain increasingly in importance in this field being distinguished by excellent adherence and simple applicability since one painting without ground coating is sufficient. GN (8f)

Electrolytic Brightening Process Improved Aluminum Reflectors. *Metal Industry,* N. Y., Vol. 32, Feb. 1934, page 59. Abstract of papers by A. B. O'Day and A. D. Dickerson and J. D. Edwards, before the Illuminating Engineering Society, Cleveland, Jan. 22, 1934. Description of R. B. Mason's development of anodic oxidation process for making reflectors of Al. PRK (8f)

Electrolytic Oxidation of Aluminium. The Alumilite Process. *Sheet Metal Industries,* Vol. 7, Oct. 1933, pages 373-375. A reproduction of an article by E. Hermann to the *Schweizerische Technische Zeitschrift,* the English translation of which appeared in Light Metals Research. The process is discussed in detail and the physical and chemical properties of the Alumilite film are given. Other coloring processes are discussed briefly. AWM (8f)

Heat Reduction by Painting (Wärmeverminderung durch Anstrich) *Farbe & Lack,* May 17, 1933, page 235. Reviews experiments of the British Building Research Station revealing that heat absorption is effectively reduced by white and Al-bronze coatings. Temperature measurements underneath various roofs showed following differences: new galvanized Fe, 63°C.; same, blackened 63°C.; sheet steel with blue enamel coating, 59.5°C.; red enamel coating, 57°C.; green enamel coating, 53°C.; white enamel coating, 38°C. The reflectivity of 14 metallic and non-metallic roofing materials toward sun light were determined. EF (8f)

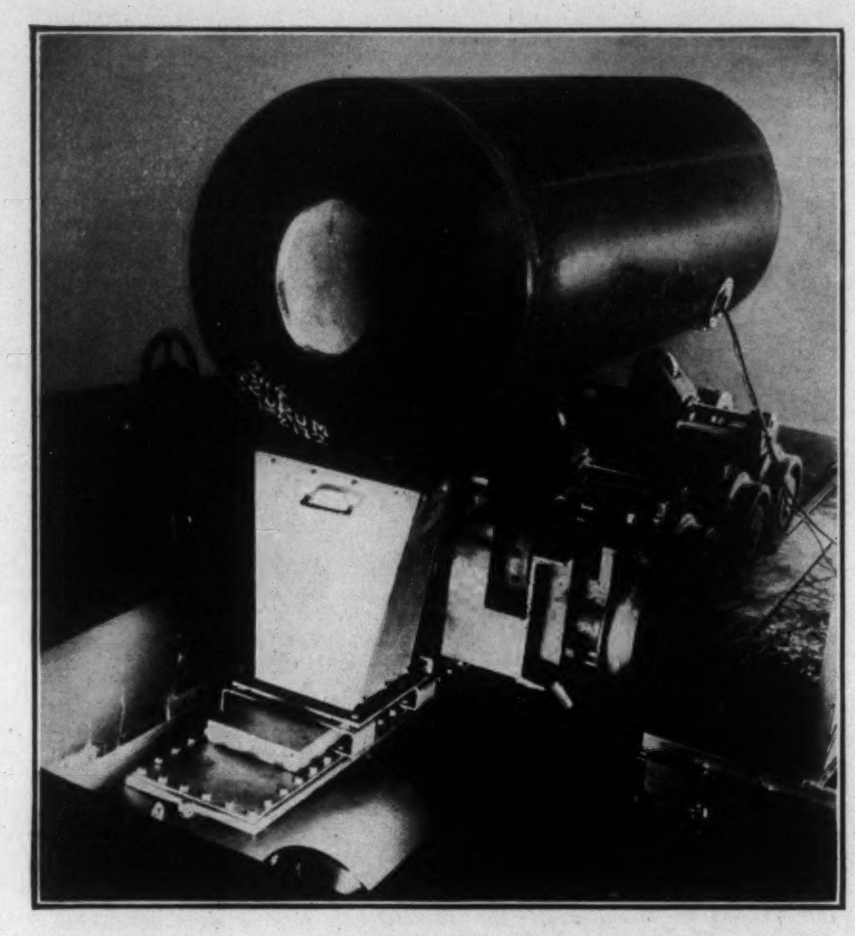
Asbestos Paints (Über Asbestfarben) *Farbe & Lack,* Sept. 13, 1933, page 443. The best heat-resistant properties are obtained if the paint contains Zn-oxide in addition to asbestos. Increasing demand by ship builders is ascribed to the remarkable resistance of asbestos paint coatings to seawater corrosion and to the low weight as compared with Pb paints previously employed. EF (8f)

Heat Resistant Dark Aluminum Paints (Hitzebeständige dunkle Aluminiumfarben) *Farbe & Lack,* Jan. 4, 1934, page 10. Fe and Cu are coated with the pure Al paint and after long drying period and subsequent heating to elevated temperatures, a coat of Al paint containing additions of graphite is applied which is also thoroughly dried before exposure to elevated temperatures. EF (8f)

Simple Testing of Rust-Protection Coatings (Einfache Prüfung von Rostschutzanstrichen) *Farben Zeitung,* Vol. 38, Dec. 16, 1933, page 1737. The method of Kempf based on the assumption that impermeability of a coating towards air and water is the principal criterion of its usefulness, is improved by H. Wulf. A strip of filter paper continuously wetted from its ends is placed upon the coated specimen to be tested. The yellow pits on the paper indicative of rusting are rendered clearly visible by a solution of 5 g. K-ferro-cyanide, 100 cc. H_2O, 1 cc. dil. HCl and 10 g. NaCl, Prussian blue being formed wherever iron rust is present. EF (8f)

Protective Paint Coatings for Mg Alloys (Zum Anstrich von Magnesiumlegierungen) *Farben Zeitung,* Vol. 39, Feb. 10, 1934, page 142. According to experiments of Bengough & Whitby the best results are obtained with either thermoprene resin or sulphur-treated oil pigmented with Zn carbonate. As the thermoprene resin did not take a top coating well sulphur-treated oil and a quick-drying tung oil base were used both pigmented with Zn-chromate. EF (8f)

Metal Protection by Paint Coating (Metallschutz durch Anstrich) *Farbenzeitung,* Vol. 38, Dec. 2, 1933, page 1688. Firm adhesion of the first paint coats on Al is of decisive influence on the serviceability of the coating. Roughening of metal surface before painting is advised. Next important is the porosity of the film and its water absorbing ability. Additions of pigments and low content of volatile solvents are urged. Light metal parts permitting baking can be ideally coated with a non-porous synthetic resin paint which is immune to water absorption. Protective action of red lead on Fe is ascribed to the formation of plumbites whereby Pb diffuses into the basis metal. EF (8f)



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TESTING (9)

Inspection & Defects, including X-Ray Inspection (9a)

C. S. BARRETT, SECTION EDITOR

Specifying Surface Quality. E. J. Abbott & F. A. Firestone. *Mechanical Engineering,* Vol. 55, Sept. 1933, pages 569-572. Surface quality, which as present is more or less a matter of personal judgment, calls for proper methods of determination. Mechanical and optical methods at present in use for measuring the roughness of a surface are described. 8 references. Ha (9a)

Roentgenographic Measurements of Elastic Stresses (Ueber die roentgenographische Messung elastischer Spannungen) H. Moeller & Josef Barbers. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Düsseldorf, Vol. 16, No. 3, 1934, pages 21-31. It was investigated under what conditions a conclusion is possible from roentgenographically measured stresses at the surface of a sample to the mean total stress in the sample. Theoretical considerations and experiments with samples of Fe and duralumin had the following results: 1. The accuracy is great in spite of the smallness of the area exposed to the X-rays; in Fe it was 2 kg./mm.^{2} 2. In general, the distribution of stresses over the section of a sample in the testing machine is irregular; where the piece is gripped additional bending stresses occur. 3. Considerably higher values of ultimate strength were observed under non-uniform stress distribution which could amount to 40%. 4. The X-ray method can be applied satisfactorily for determining local surface stresses, particularly well for non-uniform stress distribution in welds or near defects. To obtain average total stress from measurements of surface stresses the stress distribution over the section must be considered. It is explained what measurements must be made in order to determine the mean stress for non-uniform stress distribution. 8 references. Ha (9a)

X-Ray Testing of Materials (Materialuntersuchung mit Röntgenstrahlen) E. Mettler. *Zeitschrift für Schweisstechnik,* Vol. 23, Dec. 1933, pages 303-306. The chief advantage of X-ray investigation of metals is that it does not destroy the piece tested. The chief difficulties in application of this method were use of high voltages and the effect of stray rays on the operator; the fact that the equipment is usually not mobile and that great skill is required for operation of the testing machines. These difficulties have now been overcome. Charts show time and voltage required for penetration of various thicknesses of several metals. RRS (9a)

Surface of High Grade Sheet (Die Oberfläche von Feinblechen) E. Marke. *Stahl und Eisen,* Vol. 54, Jan. 15, 1934, pages 149-152. Various types of surface defects in steel sheet, arising from inclusions or other defects in the steel, or during rolling, pickling etc., are discussed. SE (9a)

Recent Progress in the X-Ray Inspection of Welds. Herbert R. Isenburger. *Steel,* Vol. 92, June 5, 1933, pages 29-32. See "Recent Developments in X-Ray and Gamma-Ray Inspection of Power-Plant Materials," *Metals & Alloys,* Vol. 4, Nov. 1933, page MA 348. MS (9a)

Radiographic Examination of Pressure Vessel Welds. R. E. Hiller. *Iron Age,* Vol. 131, May 11, 1933, pages 736-739. Describes method used to radiograph pressure vessel welds at the Barberton plant of Babcock & Wilcox Co. X-ray is generally used in preference to gamma rays because of greater economy, speed and film contrast. Gamma rays are used on sections of extreme thickness and in the field. Steps involved in obtaining radiographs are described. Most common defects are slag inclusions, which usually extend parallel to wall of joint. Porosity is next to slag inclusions in order of occurrence. Cracks and sharp lines of lack of fusion are not common. During past 2½ yrs. approximately 21,000 ft. of welded joints have been examined. X-ray examination has also been applied to castings for development of mold and casting technique. VSP (9a)

The Fracture of Screw Heads (Der Bruchweg in Schraubenköpfen) H. Kostron. *Metallwirtschaft,* Vol. 13, Feb. 9, 1934, pages 100-101. Screws or bolts with upset heads sometimes break in the head after application of a static load. The breaking is caused by sharp kinks in the fibers of the metal produced by faulty upsetting. The appearance of the fracture is similar to that produced by a fatigue failure, but can be distinguished by the ring which forms around the fracture. CEM (9a)

Determination of the Surface Area in Dense and in Porous Bodies (Bestimmung von Oberflächen dichter und poriger Körper) H. König. *Archiv für das Eisenhüttenwesen,* Vol. 7, Feb. 1934, pages 441-444. The surface area of dense ore bodies was determined by projecting them in various directions onto a screen and photographing them. In porous bodies such as coke the surface area of cross-sections was measured. SE (9a)

Measurements and Control (Metrologia e Controllo) E. Carosi. *L'Industria Meccanica,* Vol. 16, Jan. 1934, pages 15-23. General remarks on the technique of measurements, tools and instruments, readings, accuracy to be obtained. 13 references. Ha (9a)

Non-Destructive Methods of Testing Welds. J. W. Donaldson. *Iron & Coal Trades Review,* Vol. 128, Mar. 23, 1934, pages 498-499. Hydrostatic, static, acoustic, magnetic, electrical and radiographic methods for non-destructive testing of welds are discussed and their application described quite generally. Ha (9a)

Inspection of Surfaces for Minute Defects. F. A. Firestone & H. B. Vincent. *Mechanical World & Engineering Record,* Vol. 92, Nov. 4, 1932, page 431. See *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 146. Kz (9a)

Physical & Mechanical Testing (9b)

W. A. TUCKER, SECTION EDITOR

The Torsion Impact Test. G. V. Luerssen & O. V. Greene. *Proceedings American Society for Testing Materials,* Vol. 33, Part 2, 1933, pages 315-327; *Metal Stampings,* Vol. 6, Nov. 1933, pages 263-264 (Abstract). Previous methods of impact testing on very hard materials such as hardened tool steel have not always yielded results indicative of the true impact resistance of these materials, on account of variable stress concentration resulting from the character of the specimen and load application. A machine and method especially adapted to hard materials, in which the specimen is fractured torsionally under impact, are described in detail. Calibration of the machine, design of the test specimen, effect of velocity, and reproducibility of results are discussed and comparisons drawn with current methods of test on softer materials. Test data are shown on three hardened tool steels drawn over a range of hardness. MS + VVK (9b)

The Hardness Testing and Heat Treatment of High-speed Steel Tools. J. Garland. *Machinery,* London, Vol. 43, Nov. 16, 1933, pages 194-195. The best practice in the hardening of high-speed steel tools places the temperature range at 1288°-1320°C. (2350-2400°F.). This is followed by a reheating, or secondary hardening treatment at 570°-620°C. (1050°-1150°F.). Reheating high-speed steel after hardening, the hardness gradually falls to a minimum at about 360°C. (675°F.) then gradually rises again, reaching a maximum at 570-620°C. Recommended procedure for testing: (1) Rockwell test, rejecting pieces having a hardness below C 64. (2) Select a small percentage having a hardness of C 64 or over, and heat them in a salt bath 1 hour or more, according to size, to a temperature of 360-370°C. (3) Re-test Rockwell hardness. Tools which have not had the proper secondary hardening treatment will be found to lose hardness after this test. Kz (9b)

Bending and Torsional Oscillations of a Thin Crystal Rod of Isotropic Material (Über Biegungs- und Drillungsschwingungen eines dünnen kreiszylindrischen Kristallstabes von beliebiger kristallographischer Orientierung) E. Goens. *Wissenschaftliche Abhandlungen der Physikalisch-Technischen Reichsanstalt, Berlin,* Vol. 16, No. 2, 1933, pages 407-436. Advances the theory (62 formulas) of a thin cylindrical crystal rod of random orientation provided with additional masses at the test rod ends. The evaluation takes into account that bending of a crystal rod is accompanied by a torsional effect and vice versa. The derivations are applied to 2 cases of practical significance: (1) evaluation of the reciprocal torsional modulus from the basic torsional oscillations, (2) calculation of the (reciprocal) modulus of elasticity based on bending oscillations of 1 and 2 order of a plain rod. The mathematical derivations are furthermore applied to the cubic and hexagonal systems. EF(9b)

Minimum Dimensions of Test Samples for Brinell and Diamond Pyramid Hardness Tests. G. A. Hankins & C. W. Aldous. *Metal Industry,* London, Vol. 44, Mar. 9, 1934, pages 274-275. See *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 146. Ha (9b)

Hardness Testing. E. E. Halls. *Machinery,* London, Vol. 43, Nov. 2, 1933, pages 121-124; Vol. 43, Dec. 28, 1933, pages 375-378. Discussion of the more important of the existing hardness testing machines, attention being paid to their advantages and limitations. The relationship existing between the various hardness scales and between hardness and tensile strength are considered. Kz (9b)

Shearing Properties and Poisson's Ratio of Structural and Alloy Steels. Inge Lyse & H. J. Godfrey. *Proceedings American Society for Testing Materials,* Vol. 33, 1933, pages 274-285, discussion, pages 286-292. The paper describes the results of tests of different grades of structural and alloy steels to determine shearing properties (modulus of elasticity, yield point and ultimate strength) and their relation to the corresponding tensile properties. Poisson's ratio was also determined. Shearing properties were determined from slotted plate specimens tested in tension and from solid and hollow cylindrical torsion specimens. Slotted plate specimens and solid torsion specimens gave approximately the same yield point in shear. The average yield point in shear of a hollow bar was about 90% of that of a solid bar. The size of the test specimen had no effect upon the observed Poisson's ratio. Structural steel showed a wide variation in the ratio of yield point in shear to yield point in tension. In general the ratio was below 0.60 for specimens from rolled plates and structural sections. For alloy steels the ratio varied between 0.774 and 0.894 for the annealed condition and between 0.662 and 0.809 for quenched-and-drawn condition. Poisson's ratio for structural steel varied from 0.271 to 0.302 and for alloy steels from 0.272 to 0.320. 12 references. VVK (9b)

Young's Modulus of Cast Irons. Importance of Its Determination. A New Method for Its Measurement (Le Module d'Young des Fontes. Intérêt de sa Détermination. Une nouvelle Méthode pour sa Mesure) P. Le Rolland & P. Sorin. *La Fonte,* Vol. 3, July-Aug.-Sept. 1933, pages 323-331. Young's modulus is first explained. All investigators who have studied cast Fe agree upon the fact that quality of this material is in direct relation with its Young's modulus. A. Portevin has indicated that relation between modulus (M) and strength (S) can be expressed as: $M = aS+b$. This has been verified within large limits by Nicolau and de Leiris. Young's modulus varies largely, from 4,000 kg./mm.^{2} up to 16,000 kg./mm.^{2} according to quality of cast Fe. Difficulty of determination of Young's modulus is then pointed out. An accurate determination is possible only when there is accommodation of the material under repetition of deformation cycles of small importance. Method proposed follows: test bar to be studied is clamped tightly in vertical position and on this bar is fastened a horizontal bar at each end of which a pendulum is set. One of the pendulums is set in motion and it stops progressively as other pendulum is set in motion. Young's modulus is derived from time (T) between 2 stops of one of the pendulums, according to formula $M = aT$. It is only necessary to determine constant a to know M. Method can only be useful if length of test bar is sufficient comparatively to its transversal size. A table shows good agreement for 6 kinds of materials between modulus determined by means of extensometers and present method. FR (9b)

Measurement of Density, Hardness, Elasticity, Etc. E. F. Lake. *Heat Treating & Forging,* Vol. 20, Jan. 1934, pages 22-24. In interpreting hardness measurements, one must keep in mind the kind of hardness measured by the particular instrument used, i. e., tensile hardness, cutting hardness, abrasive hardness, or elastic hardness. Tough hardness, which is the most desirable for moving parts of machinery, can not be measured accurately by any of the hardness testers available. That these may give misleading or variable results is shown by variations in scleroscope readings on cast Fe pistons and in Brinell numbers of various parts of a connecting-rod. These variations in hardness readings are attributed to variations in density of the materials. File test of the pistons showed there were no hard spots and the various places were found to be equally machinable. Connecting-rod had been accurately and uniformly heat-treated. Regards file test as the best method for commercial testing of machinability and for determining hardness of balls for ball bearings. MS (9b)

Test Pieces for Irregular Castings. Roland Mitsche. *Metal Progress,* Vol. 24, Oct. 1933, pages 58, 66. Two test coupons with cross-sections corresponding with the thinnest and heaviest sections of casting are advocated to be cast in the mold with the casting. Shortening the specimen to mold accommodations within the limits $1 = 10d$ introduces no appreciable error. WLC (9b)

Tests on Stress Distribution in Welded Steel Sheets (Versuche über die Spannungsverteilung in geschweissten Flusstahlblechen) Otto Mies. *Die Wärme,* Vol. 57, Feb. 24, 1934, pages 113-121. Reports on experiments to determine the residual stresses and their distribution in sheets jointed by gas and electric welding. The release of internal stresses due to welding was accomplished by annealing followed by microscopic measurements. 6 of the 27 illustrations present in space diagrams the stresses around both kind of welds. The stresses proved to be in principle identical with both welding methods. The "absolute" largest stress occurs in the weld in the direction of the seam. (2500 kg./mm.^{2}) Perpendicular to the weld direction, tensional stresses are prevailing in general. Interpolation yielded 600 kg./mm.^{2} for autogenous welding and 1070 kg./mm.^{2} for electric welding. The yielding of the wider transitional region in case of gas welding is pointed out. In the transverse direction of the sheets, compressive stresses predominate. They are larger with autogenous welding than with electric welding. EF (9b)

New Method of Investigation on the Solid Elastic Strain Using Agar Jelly. Tadayoshi Kanao. *Journal Society of Mechanical Engineers,* Vol. 36, July 1933, pages 453-459. In Japanese. Paper read before the 220th meeting of the Society of Mechanical Engineers, Sept. 28, 1932. To measure the stress distribution in solid bodies, the author discusses an experiment using a transparent test piece (agar jelly) containing fine graphite particles. Under the microscope the author could determine the position of these particles before and their displacement after torsional stress experiments of given amount. Test results are compared with the mathematical solution. Discussion of test arrangement, test pieces and test results gained by torsional loading of square and rectangular prisms. Kz (9b)

The Actual Strength of Steel I Beams. Ewart S. Andrews. *Structural Engineer,* Vol. 12, Mar. 1934, pages 118-126; discussion pages 126-129. Albert S. Spencer. Vol. 12, Apr. 1934, page 238. A lecture delivered to the Institution of Structural Engineers, London, Jan. 1934, reports on extensive physical tests on steel I beams with the object of confirming that "the strength of steel beams under test is actually more than was thought to be the case." The testing results are graphically presented in 14 illustrations and the difficulties encountered in testing steel I beams are discussed critically. WH (9b)

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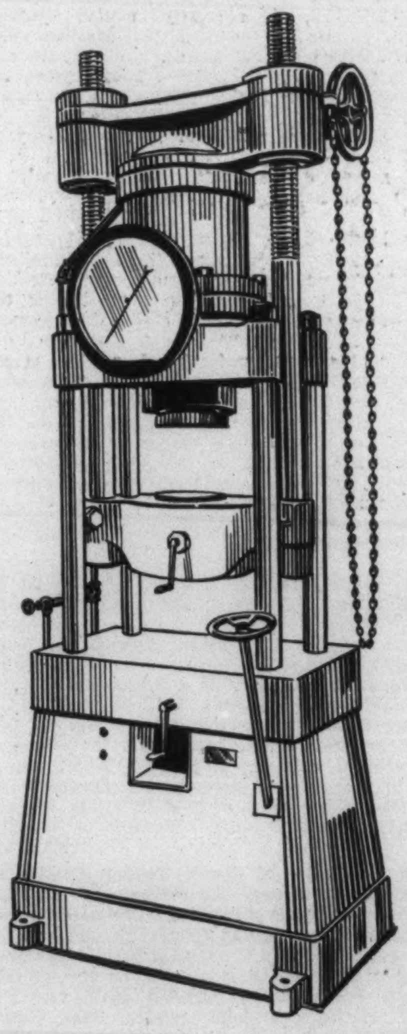

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Report of Subcommittee XV on Impact Testing (Report of Committee A-3 on Cast Iron) J. T. MacKenzie, Chairman. *Proceedings American Society Testing Materials,* Vol. 33, Pt. I, 1933, pages 87-129. This report covers data on 25 sets of cast iron test bars. The data included chemical analyses; transverse tests; tension, compression and endurance tests; shear and hardness tests; Charpy, Russell and Izod impact tests; drop tests; Krupp-Stanton repeated blow tests; and transverse test for "set." Conclusions follow: (1) The very small specimens, such as are used for steel, are not reliable indices of the impact strength of cast iron. Enger's modified Izod with a fairly large specimen is by far the best used, though there is no reason to believe the same size specimen would not give equally good, and perhaps better, results in a Charpy machine. (2) The Krupp-Stanton test gave relatively enormous differences in results for irons closely approaching each other in all other properties. It is difficult to see how this test means anything when applied to cast iron. (3) All notched specimens were unsatisfactory. (4) The tensile impact test does not seem to be a reliable index of impact value. (5) When using specimens 1.20 in. in diameter, the large pendulum machines of the Russell and Charpy type give results which follow closely the resilience measured in the transverse test. (6) The drop tests seem to indicate the impact resistance left in the bar after previous loading to a point just below the breaking point. A drop test, therefore, considered in the light of the transverse resilience would appear to be a useful index of the relative amounts of plastic and elastic deflection. (7) The bending curve of the transverse test, if the test is accurately carried out, is capable of giving most of the information needed about cast iron, and the Brinell hardness determined over the whole cross-section is the most valuable supplementary test. (8) The drop-test machines differ greatly in their construction. They would probably become quite generally used if the machines were carefully standardized in all dimensions. The tests would then give valuable corroboration to the results of the transverse tests. (9) The committee does not recommend at this time any move toward an impact requirement in specifications. **Appendix—Microstructure of Irons in Impact Investigation.** R. M. Allen, pages 130-137. This report outlines the results of microscopical examination made of the various irons studied for impact and other physical data. The nature and amount of graphite, nature of the pearlite (or other matrix), amount of free ferrite (or cementite) and amount of steadite were determined for each of the 25 irons.
VVK (9b)

How Sharply Can a Metal Part Be Bent? G. R. Gohn. *Bell Laboratories Record,* Vol. 12, Apr. 1934, pages 230-234. Testing methods and machines to determine smallest radius about which a metal may be bent without cracking are described and a curve of a 24 B. & S. gage sheet is given showing the number of bends before failure for different radii. From such curves the minimum safe forming radius is determined.
Ha (9b)

Simplified Evaluation of Plastic Deformation Speeds under the Assumption of the Gliding-Stress-Flow Condition (Vereinfachte Berechnung der plastischen Formänderungsgeschwindigkeit bei Voraussetzung der Schubspannungs fliessbedingung) A. Reuss. *Zeitschrift für angewandte Mathematik und Mechanik,* Vol. 13, Oct. 1933, pages 356-360. By means of a defined difference discriminate, the gliding stress condition can be directly expressed by the stress components without referring to the main stresses. Since the slip plane theory coincides with the flow potential theory with reference to this condition of flow, one need not know the main axes directions when evaluating the plastic deformation speeds. The components of the plastic deformation velocity can be calculated with the aid of the flow potential.
WH (9b)

Method of Execution and Research Relative to the Hardness Test (Modi di esecuzione e studi relativi alla prova di durezza) C. Montini. *La Metallurgia Italiana,* Vol. 26, Jan. 1934, pages 1-12. An outline of the different methods of determining the hardness of metals. The Brinell test is the best, because of its exactness and practicability.
AWC (9b)

Effect of an Axial Groove on the Torsional Elasticity of a Round Bar. Tosio Nisihara. *Journal Society of Mechanical Engineers,* Vol. 36, Aug. 1933, pages 521-524. In Japanese. Paper before the meeting of the Western Division of the Society of Mechanical Engineers. Discussion of tests to determine the effect of an axial groove on the torsional elasticity of a shaft. Width, depth and length of the groove were varied in the different experiments. Formulae for the yield moment and the angle of torsion are dealt with as a means of calculating the torsional strength of shafts provided with key ways or radially drilled holes.
Kz (9b)

Le Rolland and Sorin's Method of Determination of Elastic Modulus Considered as Complement of Static Transverse Test of Cast Irons (La Méthode de MM. Le Rolland et P. Sorin pour la Détermination du Module d'Elasticité Envisagée comme Complément de l'Essai de Flexion Statique des Fontes) Pierre Nicolau. *La Fonte,* Vol. 3, July-Aug.-Sept. 1933, pages 332-340. After having explained at length Brinell test, shear test and transverse test advocated by the French Association for cast Fe testing, authors report results obtained on 7 cast Fe largely different as to their quality (Young's modulus varying from 6,360 kg./mm.^{2} to 16,000 kg./mm.^{2}). Comparison is made between results of mentioned current tests and elastic modulus. General conclusions are: (1) Le Rolland & Sorin's method classifies cast Fe in quite same order as Brinell test. (2) Linear relation between ultimate strength in shearing and transverse test is once more verified. (3) Order of classification of cast Fe by ultimate transverse strength and shearing strength differs notably from that of elastic modulus. (4) Breakage modulus (or Meyersberg's number i. e., ratio between ultimate transverse strength and breaking deflection) as well as tangent at starting point and average tangent of straight portion of the curve give same order of classification as Le Rolland & Sorin's modulus except for 2 high phosphorus cast Fe but classification is much more clear with elastic modulus. (5) Tangent at starting point of the curve is in best accordance with Le Rolland & Sorin's modulus which is quite logical since this modulus corresponds to starting point. In last section of his article, author reviews objections which could be made to the new method but he hopes that this method will be of much interest for gray Fe founders.
FR (9b)

Fatigue Testing (9c)

The abstracts appearing under this heading are prepared in co-operation with the A.S.T.M. Research Committee on Fatigue of Metals.

Metal Strength Increased by Graduated Stressing. J. B. Kommers. *Steel,* Vol. 94, Mar. 5, 1934, page 26. Results of investigation show that endurance limit of cast-Fe and of hot rolled Fe may be increased as much as 31% and 25% respectively by applying a low understress and increasing this gradually while the specimens are being rotated in the testing machine. When a constant stress slightly less than the original endurance limit is applied, the increase is only 25% and 10% respectively. Notched, low-strength cast-Fe does not have a lower endurance limit, and, in addition, is greatly strengthened by gradual increases of understresses. With Fe, however, as the strength increases, the material becomes more sensitive to the notches, with the result that the endurance limit is gradually reduced by a greater percentage.
MS (9c)

Influence of Corrosion on Torsional Endurance Limit of Steel and Non-Ferrous Alloys (Der Einfluss der Korrosion auf die Drehschwingungsfestigkeit von Stählen und Nichteisenmetallen) T. Dusold. *Metallwirtschaft,* Vol. 13, Jan. 19, 1934, pages 41-44. See *Metals & Alloys,* Vol. 5, Feb. 1934, page MA 48.
CEM (9c)

Corrosion Fatigue and Sucker Rod Failures. Blaine B. Westcott & C. Norman Bowers. *Oil & Gas Journal,* Vol. 32, Oct. 26, 1933, pages 65-72. This paper presents an interesting discussion of the importance of corrosion-fatigue in the case of sucker rods. A table of materials used for sucker rods is given including a statement of heat treatments used. Another table gives the different types of corrosion and the chemical agents which seem to be active agents in producing this corrosion. Two tables of fatigue properties of iron and steel are given, one comparing endurance limit as given by rotating-beam machine with endurance limit for reversed axial stress. Some of the values for ratio of these two endurance limits indicate rather unusually low values of axial endurance limit. A very interesting table given is the following:

Fatigue Properties of Low Manganese Steel, Wrought Iron and Nickel Wrought Iron

Fatigue limit determined by endurance of 10,000,000 cycles of stress.

	Fatigue limit lb./in.^{2}			Ratio of fatigue limit to tensile strength		
Conditions of test:	1.25% manganese steel	Wrought Iron	Nickel Wrought Iron	1.25% manganese steel	Wrought Iron	Nickel Wrought Iron
Noncorrosive (ordinary fatigue limit)	48,900	30,400	40,100	0.49	0.64	0.64
In oil well water saturated with natural gas and free from air	19,600	19,600	25,600	0.20	0.41	0.41
In oil well water saturated with natural gas and hydrogen sulphide and free from air	14,600	16,400	14,900	0.15	0.34	0.24

The high ratios of fatigue limit to tensile strength for wrought iron and nickel wrought iron both under corroding conditions and non-corrosive conditions are especially noteworthy. The authors explain this by relatively low susceptibility of wrought iron to stress concentration conditions. They give an explanation based on a formula developed by B. P. Haigh. In effect their explanation is that a material like wrought iron which under one-way repetition of stress has an endurance limit greater than its yield strength, offers a chance for stress redistribution around the end of a crack which is more effective in reducing stress concentration than is the redistribution of stress effected in a stronger alloy steel, which has its endurance below the yield strength, even for one-way cycles of stress.
HFM (9c)

Investigation of Fatigue Fractures (Die Beurteilung von Dauerbrüchen) A. Thum & H. Oschatz. *Metallwirtschaft,* Vol. 13, Jan. 5, 1934, pages 1-8. From the appearance of a fatigue fracture it is usually possible to determine what part of the fracture is due to fatigue and what part due to sudden breaking. In steel parts the fatigue fracture is smoother and finer grained than the sudden fracture, while in bronze parts it is usually the opposite. The fatigue fracture is often smooth due to the two parts rubbing against each other after the fracture has started. Recent investigations indicate that when fatigue breaks start slip-planes form in crystals in the overstressed zone. In normal fatigue breaks the fracture takes place through the crystals while in the presence of alkalis and some other corrosive media the fracture is intercrystalline. Fatigue fractures usually, but not necessarily, show the characteristic progressive lines which indicate the path along which the fracture proceeds. The typical forms of fractures due to tensile and compressive, single bending, double bending, circular, and torsional stressing, with and without notches are described. From the appearance of the fracture it is possible to draw conclusions as to type of stressing, the amount of overstressing, the start of the fracture, and how it progresses. Regardless of the type of stress the path of the fracture is always at right angles to the lines of force and is often not the shortest distance through the piece, but curved. The shape of the fracture can be used to determine the direction of forces and stresses in complicated shapes. 6 references.
CEM (9c)

Fatigue of Metallic Materials (Ermüdung metallischer Werkstoffe) Paul Ludwik. *Forschungen & Fortschritte,* Vol. 9, June 1933, page 274. Calls attention to the harmful effect of surface inhomogeneities and of corrosive action on the fatigue of metallic materials. An oscillating stress often is superimposed on a constant static load in machinery parts. Bending and torsion tests yielded an approximately proportional increase of fatigue strength with increasing steady static loads in polished, grooved, and corroded samples.
EF (9c)

Dynamic Elasticity. Recording of Mechanical Oscillations, Vibrations and Distortions (Elasticité Dynamique. Enregistrement d'Oscillations, de Vibrations et de Déformations Mécaniques quelconques) E. Marcotte. *Arts-et-Métiers,* Vol. 85, Mar. 1933, pages 76-83. Importance of fatigue strength of materials is first emphasized and it is shown that static stresses alone have been considered in studying materials for too long a time. Now, up to date question is to study elastic deformations under alternate dynamic stresses. In measurements made, problem met with is to take care of inertia of recording apparatus. Then new mechanical and electrical apparatus of A. Blondel, i.e., devices with mirrors and devices based on application of induction, and optical apparatus of Mabboux and Tesar are described at length.
FR (9c)

Crystalline Structure in Relation to Failure of Metals—Especially by Fatigue (Edgar Marburg Lecture) Herbert John Gough. *Proceedings American Society Testing Materials,* Vol. 33, Pt. II, 1933, pages 3-114. Reprint American Society for Testing Materials, 1933, Paper 6 x 9 inches, 111 pages. Extended abstract by H. W. Gillett. *Metals & Alloys,* Vol. 4, No. 9, Sept. 1933, pages 140-142. Considering the basic problem of the failure of metals as that of the property and nature of the cohesion of solids, the author discusses the nature of the atom bond, the structure of solids, the method of preparation of single metallic crystals, crystal structure, the distortion of single metallic crystals under simple static stressing systems, the influence of the intercrystalline boundary upon static strength and distortion, effects of cold-working on single crystals and polycrystalline aggregates, cold-working in relation to crystalline structure, failure under repeated cycles of stress or "fatigue" in relation to the crystalline structure, and comparative behavior of single crystals and polycrystalline aggregates.
WLC+VVK (9c)

Newer Results of Material Testing and Their Applicability (Die neueren Ergebnisse der Werkstoffprüfung und ihre Anwendbarkeit) R. Mailänder. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 24, Feb. 25, 1934, page 102. Author discusses in particular factors affecting fatigue properties of materials, as initial stresses (casting and welding stresses, stresses due to heat treating or non-uniform working), surface condition and dimensions of pieces tested, effect of notches, bore holes and corrosion. Particular behavior of cast Fe is finally pointed out.
GN (9c)

On the Fatigue Limit of Steel Rods Provided with Rolling Skin and Bores at Compressive Loads (Über die Dauerfestigkeit von Stahlstäben mit Walzhaut und Bohrung bei Druckbelastung) Otto Graf. *Der Stahlbau,* Vol. 7, Jan. 19, 1934, pages 9-10. The test samples subjected to fatigue tests, about 2,000,000 cycles, were prisms made of steels St. 37 and 60. It resulted that the resistance against crack formation of samples of St. 60 is but slightly higher than that of samples of St. 37. Furthermore, the loads that lead to crack formation at a like load cycles were for St. 60 but slightly higher than for St. 37. GN (9c)

Flexure Fatigue Studies of Cast Dental Gold Alloys. FLOYD A. PEYTON. *Journal of the American Dental Association,* Vol. 24, No. 3, Mar. 1934, pages 394-415. The alloys had the compositions: No. 1, Au 67.8, Ag 12.0, Cu 11.9, Pt 2.5, Pd 4.0, Zn 1.6, Ir 0.2%; No. 2, Au 65.8, Ag 12.7, Cu 17.5, Pt 0.8, Pd 7.0, Zn 1.0, Ir 0.2%; No. 3, Au 63.3, Ag 14.4, Cu 18.0, Pt 1.5, Ni 0.97, Zn 1.7, Ir 0.1%. The physical properties, including the endurance limits, of these are reported in the following table:

Alloy No.	Heat Treatment	Proportional Limit	Tensile Strength	Elongation, Per Cent	Modulus of Elasticity	B.H.N.	Endurance Limit, lbs./in.^{2}*
1	Oven Cool	74,000	97,000	1.0	13,300,000	260	51,500
2	700°C. Quench	55,000	78,000	13.5	11,100,000	127	61,000
3	700°C. Quench	40,000	70,000	23.0	10,700,000	135	59,000

*for approximately 25 million cycles. (Abstractor's note: The high endurance ratios, around 80% on the quenched materials, are much higher than any authenticated endurance ratios for other alloys and raise the question whether the calculated nominal stress in the endurance tests is not far higher than the true stress.) The cast specimens were approximately 2¼ in. by 2 mm. by 1 mm., and the specimens tested in flexure were 1 in. long, 2 mm. wide, and from 0.5 to 1.1 mm. thick. A ½-in. length was bent either .050 or .030 in., the stress being varied by changing the thickness. Most of the tests were at high stresses, which caused failure in less than 5 million cycles, although at lower stresses some tests were run to 50 million cycles without causing failure. The results obtained are plotted in S-N curves which are similar to those found for base metals. A flexure machine has been developed and is described briefly (more in detail in International Journal Orthodontia, Vol. 19, Aug. 1933, page 779). P. concluded that the M. E. may be an important property from the standpoint of design of structures and that there was no outstanding evidence of a relation of fatigue limit to the other physical properties. Fatigue fractures were transcrystalline. Sixteen references. OEH (9c)

Experiments of Endurance Tests (Dauerfestigkeitsversuche) OTTO GRAF. *Zwanglose Mitteilungen, Fachausschuss der Schweisstechnik, Verein deutscher Ingenieure,* No. 23, Dec. 1933, pages 3-4. Report on the progress of the work concerning tests on welding of fillet seams with different electrodes. Gas fusion welding showed better results than electric arc welding. Cylindrical rods of 5 mm. made from welds had an upper elastic limit (load with 0.2% permanent elongation) of 34-45 kg./mm.^{2} for gas welding, 19 kg./mm.^{2} for electric welding; ultimate elongation (at fracture) was 20 and 16% resp. Preliminary tests with welded girders make an assumed shearing strength of 12 kg./mm.^{2} advisable. Although so far stresses due to shrinking seem not to have an effect on endurance strength it is recommended to investigate this question further. Ha (9c)

Fatigue and Hardening of Steels. HERBERT J. FRENCH. *Transactions American Society for Steel Treating,* Vol. 21, Oct. 1933, pages 899-946. Extended Abstract by H. W. GILLETT. *Metals & Alloys,* Vol. 4, Nov. 1933, page 170. The proportionality between strength or hardness and endurance limit fails to hold for quenched steels unless tempered below 450 Brinell. Various alloy steels quenched and temper softened substantially will show the same endurance limit when heat treated to the same strength and hardness. The hardened, untempered or slightly tempered steels tend to show delayed fracture, taking place after 10,000,000 cycles which will ordinarily develop the endurance limit. Water-quenched high-C steel under repeated stress shows endurance limit of 75,000 lbs./in.^{2} while oil quenched alloy steels show 90,000 or more. From this it is deduced that retained austenite by its ductility improves the resistance to fatigue. Determinations of retained austenite by magnetic and other methods give data consistent with this theory. In order to make sure that delayed fracture might not take place in bars removed unbroken at 10-25,000,000 cycles they were run at somewhat higher stress and their retest life compared with the normal life at that stress to determine the presence or absence of damage. Damage resulting from overstressing and improvement resulting in strengthening by understressing. Since in springs and battering tools the ability to take occasional overstress is important it was desired to determine the limits of that overstress which would not cause damage. Bars run for various numbers of cycles at stresses over the endurance limit were run at the endurance limit for unstressed bars. Those which broke short of 10,000,000 cycles had been damaged and from such tests a damage line could be drawn on the S-N diagram. The benefit of tempering on the endurance of quenched steels is readily seen in the damage lines. The area of no damage under the S-N curve increases with tempering. An interesting observation was made on two age-hardening steels in that they exhibited no area of no damage, while quenched and drawn alloy steels show a large area of no damage. A Ni-Si steel (0.49% C, 0.83 Mn, 3.52 Ni, 1.65 Si) showed when quenched in oil from 1575°F. and tempered at 1200° F. a very high endurance limit for its strength but very little resistance to damage. When tested untempered or tempered at 675°F. it was found to be actually improved by overstress. This steel was induction furnace made. Another heat of arc furnace steel of similar composition showed small no-damage area but a higher endurance limit than that exhibited by the induction furnace steel after the improvement due to overstressing. 38 references in original article. WLC (9c)

Oscillating Tests with Welded Samples (Schwingerversuche mit geschweissten Proben) FIEK. *Zwanglose Mitteilungen, Fachausschuss der Schweisstechnik, Verein deutscher Ingenieure,* No. 23, Dec. 1933, pages 4-5. Report on progress of work with combinations of different welds, butt-, lap-, fillet gas welds on structural steel St 37; stress per cycle varied between 800 and 1600 kg./cm.^{2} at 4-4.2 cycles per sec. (In general, conclusions based on number of cycles before fracture have not been found very reliable. This is especially true in this case, since the stresses used varied between 800 and 1600 kg./cm.^{2}—H. F. Moore) The endurance figures were for short side seam, 0.6x10^6; long side seam, 1.5x10^6; short side and front seam, 2.6x10^6; round laps, 1.5x10^6; tapered laps, 1.95x10^6 changes of load. Still better values were obtained in V-joints and laps with side fillet welds, no break occurred after 10.8x10^6 changes of load; the same electric weld showed only 2.5x10^6 changes. A number of other tests were made with gas-welded butt-joints which gave good results particularly if a subsequent welding at the bottom of the weld is applied. Samples with longitudinal seams showed throughout higher endurance figures than transversal seams, about 15-19 kg./mm.^{2} for a material of 30-32 kg./mm.^{2} tensile strength. Ha (9c)

Fatigue and Corrosion Fatigue with Special Reference to Service Breakages. FREDERIC BACON. *Proceedings of the Institution of Mechanical Engineers,* Vol. 124, June 1933, pages 685-736. Gives special attention to the crack spreading process for the purpose of interpreting the features found on fatigue fractures and as a method of attacking the problem of crack formation from a new angle. Fatigue testing machines and material used are described. Fractured faces of shafts, axles, and similar parts subject to rotary bending show that constantly recurring types approximate simple geometrical markings. Attention is given to the weakening effect of the local concentrations of stress produced by holes, shoulders, keyways, etc. Includes 2 examples of an attempt to locate and assess the diminution of fatigue resistance at the weakest spot of a projected design by a single fatigue test of a suitable model. Reviews the history of corrosion fatigue and gives a list of practical instances where corrosion fatigue is known or suspected to be the cause of failure. Discusses and illustrates pitting and cracking processes peculiar to corrosion fatigue, the corrosive agent being a small steam jet in air. Gives chemical analysis of steels used, heat treatment, results of static tensile tests, hardness, notched-bar impact, and fatigue tests. RHP (9c)

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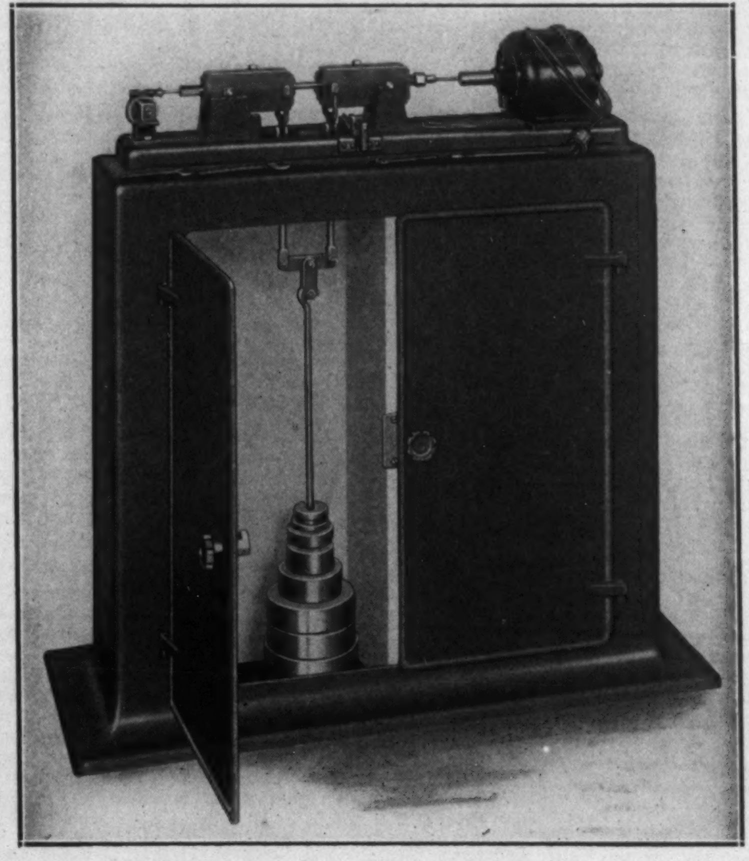

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Effect of Internal Stresses on Vibration Strength (Ueber die Wirkung von Eigenspannungen auf die Schwingungsfestigkeit) H. Buehler & H. Buchholtz. *Mitteilungen aus dem Forschungsinstitut Vereinigte Stahlwerke Aktiengesellschaft Dortmund,* Vol. 3, No. 8, 1933, pages 235-248. While the strength of plastic materials under mainly static stresses is practically not influenced by internal stresses such influence must be taken into account under vibrating stresses when interior stresses are present. If vibrating stresses are uniformly distributed over the section interior stresses must be considered as a dangerous pre-imposed stress, and also under non-uniform stress distribution inner stresses may have an injurious effect. On the other hand, interior stresses which remain from heat-treatments, that is, thermal stresses which are characterized by compressive stresses at the edges and tensile stresses in the core, increase vibration strength under bending and torsion; but vibration strength is reduced under these conditions when tensile stresses occur in the edges and compressive stresses in the core as it is the case in hardened tool steels and after cold-drawing. Endurance bending tests with different steels have shown that without change of static properties of strength vibration strength is increased 15-20% by high compressive stresses at the edge caused by quenching from temperatures below A_1. Although bending-vibration strength is reduced about 15% by high original tensile stresses in the edge zones, low original stresses (under 20 kg./mm.^{2}) have no injurious effect on bending strength if the material is sufficiently tough. Already existing interior stresses before the test are relieved to a very great extent under vibrating stress by small plastic deformations. 16 references and 4 tables of charts representing results in detail. Ha (9c)

State of Stress and Tensile Strength of Flank Seam Joints (Spannungszustand und Festigkeit von Stirnkahlnahtverbindungen) G. Bierett & G. Grüning. *Die Elektroschweissung,* Vol. 5, Feb. 1934, pages 33-34. The states of stress in the cross joint and the flank seams of fish plate joints were determined by elongation measurements on models. These non-welded models were made of steel plate. Table shows maximum stresses set up in these models. These stress measurements were supplemented by fatigue tests on similar non-welded models made of St. 37 steel plate in order to determine the effect of the geometrical shape on the fatigue limit, independent of the flow of material. The fatigue properties of these models were not better than those of correspondingly welded samples. It results that the considerable decrease in strength of weld joints in dynamically testing is chiefly due to the commonly unfavorable geometric shape of the joints considered. Therefore, shapes must be found by constructors that lessen the stress maxima thus to attain higher fatigue limits. Gradual transition from sheet surface to seam surface is of essential importance for good fatigue properties. GN (9c)

Corrosion-Fatigue Tests on Mild Steel. *Engineering,* Vol. 136, Oct. 6, 1933, page 398. The National Physical Laboratory at the request of Messrs. Fescol, Ltd., London, tested mild steel which had been coated with Ni by the "Fescolising" process. The results showed that Fescolising mild steel increases its endurance limit (20,000,000 cycles of reversal flexure) by 67%. A table and graph show the results of these tests. LFM (9c)

Transverse Fissure Failures. *Proceedings, American Railway Engineering Association,* Vol. 33, 1932, pages 557-558, 808-815. Appendices B-1 and B-2 to the report of Committee IV on Rails. Includes statement by H. F. Moore on progress of investigation at University of Illinois on fissures in rails. Physical and chemical tests, metallographic examination, and etching tests have been carried out on rails whose rolling history is known. Deep etching is the surest way of finding shatter cracks. X-ray spectrograms and the drop-of-potential method have not been successful as non-destructive methods of detection. A repeated stress machine in which the rail is moved below a car wheel is described. A fissure fracture developed in the first specimen to be tested, but later specimens have all failed by progressive failure from the surface. (An abstract of a later oral statement on the progress of this investigation is given in *Railway Age,* Mar. 21, 1934, page 401: H.F.M.) JCC (9c)

Experiments on Notch Endurance Strength and Corrosion Fatigue of Boiler Construction Materials (Versuche über Kerbdauerfestigkeit und Korrosionsermüdung an Kesselbaustoffen) A. Thum & Cl. Holz. *Die Wärme,* Vol. 56, Sept. 30, 1933, pages 640-642. The different sources leading to the development of cracks in boiler parts are pointed out. Accumulation of stresses and alternating stressing result in fatigue failures. The results gained on endurance tensile tests (constant static load and additional oscillation stress) reveal the paramount influence which the quality of the boiler material, the extent and shape of grooving and the magnitude of prestressing exert on the maximum endurance strength. Chemical effects active during these endurance tests may accelerate materially or inhibit the formation of cracks depending on the type of attack. In contrast to general corrosion attack, intergranular corrosion takes place at sufficiently large stresses and moderate corrosive power in passifying solutions. The experimenters devised a new testing method permitting tests at high pressures and elevated temperatures. The endurance tests with grooved samples were carried out in air and then studied under "service conditions." Smooth surfaces raised notably the fatigue resistance which was 40% higher for semicircular grooves as compared with sharp notches. Soda lyes (280 g./liter) drastically reduced the endurance strength due to corrosive action. Lye concentrations of 0.7 g./l. as prevailing in boilers, check the corrosion progress, retard the crack formation and raise the endurance strength. Trisodiumphosphate displayed a protective behavior towards general corrosion attack. EF (9c)

Piston Rod Failures in Large Double Acting Two-Cycle Diesel Engines. *Motor Ship,* Vol. 14, Oct. 1933, pages 236-238. The main causes of failure are internal corrosion due to the presence of air in the cooling water, and heat stresses combined with repeated alternating stresses. This corrosion-fatigue is prevented by minimizing the corrosion in the internal surface of the rod by fitting a nickel steel or a cupro-nickel tube in the rod, or by the use of inhibitors such as potassium chromate solution. JWD (9c)

The Significance and Limitations of Fatigue Test Results. R. E. Peterson & H. F. Moore. *Iron & Steel Industry & British Foundryman,* Vol. 5, Sept. 1932, pages 437-438. See *Metals & Alloys,* Vol. 5, Jan. 1934, page MA 11. CHL (9c)

Relation of Fatigue Strength and Notch-Susceptibility in Fatigue to the Other Tensile Properties of Steel (Biegeschwingungsfestigkeit und Kerbempfindlichkeit in ihrer Beziehung zu den übrigen Festigkeitseigenschaften bei Stahl) W. Lequis, H. Buchholtz & E. H. Schulz. *Stahl und Eisen,* Vol. 53, Nov. 2, 1933, pages 1133-1137; *Mitteilungen aus dem Forschungsinstitut der Vereinigte Stahlwerke Aktiengesellschaft Dortmund,* Vol. 3, June 1933, pages 129-152. Fatigue, corrosion-fatigue, tensile, and impact tests were made of a 0.12% C structural steel and a 0.19% C; 0.75% Mn; 1.02% Cu; 0.64% Cr steel after various heat treatments and aging treatments. The fatigue tests were made on polished and on notched specimens; the impact tests over temperatures between — 80 and 200°C. No relation could be drawn between the form of the stress-strain curve at the yield point and the endurance limit; there seemed to be no connection between notch-susceptibility in fatigue tests and notch-toughness in impact tests. In the corrosion fatigue tests higher endurance values were obtained where numerous shallow "corrosion notches" were formed than where a few deeper cracks appeared. Coarse grain caused greater notch and corrosion susceptibility and lower endurance limit. For ordinary fatigue testing under non-corrosive conditions the following formula is submitted, $\sigma_w = 0.175\ (\sigma_z + \sigma_s - \delta_{10} + 100)$ where σ_w is the endurance limit, σ_z the tensile strength, σ_s the yield strength, δ_{10} the percent elongation. Ha+SE (9c)

Judging Material Properties from Fatigue Fractures (Beurteilung von Werkstoffeigenschaften aus Gewaltbrüchen) H. Holdt. *Schriften der Hessischen Hochschulen,* 1933, No. 2, pages 26-30. Paper before Werkstofftechnisches Kolloquium der Staatlichen Materialprüfungsanstalt an der Technischen Hochschule Darmstadt, June 24, 1933. Results of tests on the various types of crack structure occurring in boiler materials are given and discussed. In the first place the type of crack structure in the same boiler material depends on the testing conditions. Granular, slaty and tough fibrous fracture are distinguished. Granular fracture is generally apparent in brittle plates, tough fibrous fracture predominates in very tough homogeneous plates, slaty fracture in very homogeneous plates and rather alike in less homogeneous plates of greater thickness. A fourth type of fracture is observed in segregated plates or those with heavy slag inclusions. A characteristic "step" fracture is then observed. Better than by fracture tests and microscopic examination the uniformity of plates can be tested by etching tests. However, reliable conclusions in how far structural inhomogeneities are detrimental can be drawn only from fatigue tests. Judging material properties from fracture tests requires considerable experience. GN (9c)

Effect of Internal Stresses on the Endurance Limit in Repeated Bending (Die Wirkung von Eigenspannungen auf die Biegeschwingungsfestigkeit) H. Bühler & H. Buchholtz. *Stahl und Eisen,* Vol. 53, Dec. 21, 1933, pages 1330-1332. Internal stresses were introduced into carbon and silico-manganese structural steels by quenching from 600°C. without appreciably changing the hardness. The resulting compressional stresses at the surface raised the endurance limit in bending up to 20%. On the other hand high tensional stresses at the surface such as may be obtained by quenching from above the critical temperature or by cold drawing lowered the endurance limit. Small internal stresses are without effect if the steel is sufficiently tough. During the fatigue tests the internal stresses tended to be reduced, presumably on account of slight plastic deformation. SE (9c)

Fatigue Strength of Airplane and Engine Materials. Kurt Matthaes. *Technical Memorandum No.* 743 *National Advisory Committee for Aeronautics,* Apr. 1934, 31 pages; Translated from *Zeitschrift für Flugtechnik und Motorluftschiffahrt,* Vol. 24, Nov. 4, 1933, pages 593-598; Nov. 28, 1933, pages 620-626. A brief but quite intensive treatment of fatigue phenomena is given. The following topics are treated: kinds of fatigue stresses, typical fractures, effect of frequency, initial tension, relation between fatigue strength and static strength, effect of surface finish and treatment, effect of stress concentration at fillets, holes, key ways, threads, and welds. From the viewpoint of the designer there is no fatigue strength based simply on the material. The fatigue strength of structural parts can be approximately estimated by allowing for the influence of form, surface finish and other factors. 23 references. Kz+HWR (9c)

Combating Corrosion Fatigue of Steel (Erklärung und Bekämpfung der Korrosionsermüdung von Stahl) O. Föppl. *Die Naturwissenschaften,* Vol. 27, Dec. 15, 1933, page 888. Author calls attention to the fact that the corrosion fatigue limit of steel rods under alternating bending can be raised by submitting the samples to compressive stress. In agreement with McAdam's observations in endurance tests, untreated samples exhibited in water only 1/5 of the fatigue strength in air. The corrosion fatigue limit, however, can be raised even above the limit in air by "densifying" (rolling) the surface of the steel previous to fatigue testing. Experiments with an electro Cr-Ni steel yielded the following endurance bending strengths:

untreated, in air	45 kg./mm.^{2}
pressed, in air	55 kg./mm.^{2}
untreated, in water	11 kg./mm.^{2}
pressed, in water	47 kg./mm.^{2}

The minute surface defects, at which fatigue failures start, are reduced by the mechanical treatment previous to endurance exposure. EF (9c)

Fatigue Tests on Welds of Mild Steel and Cr-Mo-Steel (Essais de Fatigue sur les Soudures d'Acier doux et d'Acier au Cr-Mo) L. Doussin. *Usine,* Vol. 43, Mar. 15, 1934, page 31. The fatigue limit lies for most metals below their elastic limit except for brass (Also for very soft iron and markedly higher for soft copper: H. F. Moore) where it is slightly higher; the fatigue limit changes according to kind of stress. The ratio of fatigue to elastic limit is not constant even for the same metal. Principal factors influencing fatigue limit are: dimensions of the piece, distribution of stresses, condition of surface; the latter can, under certain conditions lower the fatigue limit to 2/3 or even 1/3. The fatigue limit of a structure as a whole depends mostly on stress distribution. Ha (9c)

Standardisation of the Alternating Bend Test for Thin Mild Steel Sheets. J. C. Godsell. *Sheet Metal Industries,* Vol. 7, July 1933, pages 145-146. Discusses the influence of varying radius of bend with materials of constant thickness. In the equation $N = K\ (R/T - 0.8)$, where $N =$ number of bends, $T =$ thickness of test strips, and $R =$ radius of jaws used, the value of the constant K depends on the quality of the material (as measured by the bend test) only, irrespective of thickness or radius of bend, and it is suggested that this be adopted as standard for expressing the quality of mild steel sheets and tinplates. This is a measure of stamping and seaming qualities. AWM (9c)

Investigations on Steel Bars under Changing Tensile Stress (Untersuchungen an Stahlstäben bei wechselnder Zugbeanspruchung) A. Pomp & M. Hempel. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Düsseldorf, Vol. 15, No. 18, 1933, pages 247-254. A machine is described in which static and dynamic tests, in particular alternating endurance tensile tests were made. The results of tests with structural steels St 52 (0.11 C, trace Si, 0.47 Mn, 0.010 P, 0.023 S, 0.19 Cu,—Cr) and St 37 (0.13 C, 0.4 Si, 1.22 Mn, 0.019 P, 0.024 S, 0.39 Cu, 0.04 Cr) are given in curves, tables and micrograms. The tests show that the first sign or fine cracks of an endurance fracture depend, besides the amplitude of vibration stress and frequency of vibrations, on small inhomogeneities and defects of the material or on surface injuries which cause a local increase of tension due to their notch action. For details the paper must be referred to. 18 references. Ha (9c)

Influence of Corrosion on Endurance of Steels and Nickel (Der Einfluss der Korrosion auf die Biegungsschwingungsfestigkeit von Stählen und Reinnickel) O. Behrens. *Metallwirtschaft,* Vol. 13, Jan. 19, 1934, pages 44-46. See *Metals & Alloys,* Vol. 5, May 1934, page MA 212. CEM (9c)

Magnetic Testing (9d)

L. REID, SECTION EDITOR

Non-Destructive Testing of Welded Seams (Aus der Praxis der zerstörungsfreien Schweissnahtprüfung) S. Kiesskalt. *Autogene Metallbearbeitung,* Vol. 27, Mar. 1, 1934, pages 65-68. The manipulation of a magneto-acoustic testing device is explained and illustrated by some examples; the method consists in moving a little magnetizing coil which is excited by the normal alternating current supply, over the welded seam; the magnetic leakage changes when defective spots are in the weld and causes noises or sounds in a pair of earphones which the tester has on his head. The greatest thickness of material for which the instrument will give reliable results is 16 mm. Ha (9d)

Silicon Steel with A.C. and D.C. Excitation. R. F. Edgar. *Electrical Engineering,* Vol. 53, Feb. 1934, pages 318-322. Magnetic tests on Si-steel at 60 cycles with superposed d.c. excitation are described. Results are shown in a series of curves. A bibliography is appended. WHB (9d)

Bars Tested Magnetically for Seams and Internal Defects. *Iron Age,* Vol. 132, Aug. 3, 1933, pages 16-17. Describes the testing of cold drawn steel bars magnetically by the Union Drawn Steel Co. for internal defects. Seams and other defects that are in excess of 0.005 in. deep are detected magnetically and indicated by the contour of a curve produced by a beam of light. The apparatus was developed by the Magnetic Analysis Corp'n. This method of testing is especially desirable for cold finished bar stock used in making piston pins and in connection with steel used for airplane parts. Another use is for identification of mixed grades of steel varying in analysis. VSP (9d)

Spectrography (9e)

A Symmetrically Opening Optical Slit. J. E. Sears. *Journal of Scientific Instruments,* Vol. 10, Dec. 1933, pages 376-377. Description of a new type of symmetrically opening slit for use with spectrometers and similar apparatus. RAW (9e)

Routine Application of Chemical Emission Spectrum Analysis for Industrial Testing of Materials (Die betriebsmässige Anwendung der chemischen Emissions-Spektralanalyse bei Werkstoffuntersuchungen in der Industrie) H. Moritz. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, Dec. 16, 1933, pages 1321-1327. While X-ray spectroscopy is already a fairly known method for detecting traces of metallic impurities in industrially used materials the emission spectrum of materials has not yet been used to the same extent although this method is, from the practical viewpoint still more sensitive, simpler and also cheaper. The principles of spectrum analysis are explained and its application for the analysis and determination of constituents of a material by means of a standard spectrogram or spectrum chart is described. Instruments and apparatus for evaporating the sample are discussed; the method is applicable for investigation of segregation phenomena, defects, determination of isotopes and atomic constants, and for pathological investigations. The accuracy of the method is the better the lower the content of the impurities to be discovered is, usually less than 0.5%; the average error is about 10%. 20 references. Ha (9e)

Frequency of Zirconium (Die Häufigkeit des Zirkoniums) G. von Hevesy & K. Wuerstlin. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 216, Jan. 26, 1934, pages 305-311. 1175 samples of rocks and several meteorites were examined X-ray spectrographically for Zr. Content of Zr was found to average 1 g. Zr in 1000 g. in eruptive rocks, 1 g. Zr in 4500 g. effusive rocks, and in sediments about half the latter. The Zr content in meteorites was found to be 1 g. in 12000 g. stone meteorites. Tables are given with Zr contents of various ores and rocks, and where deposits occur. Ha (9e)

Contributions to Technical Spectrum Analysis in the Metallurgical Laboratory (Beiträge zur technischen Spektralanalyse im Eisenhüttenlaboratorium) W. Gerlach. *Archiv für das Eisenhüttenwesen,* Vol. 7, Dec. 1933, pages 353-354. The careful work of Scheibe (*Archiv für das Eisenhüttenwesen,* Vol. 4, 1930-1931, pages 579-584) on the spectrum analysis for Si in Fe-Si alloys is discussed It is shown that the Si line 2516 is not particularly suitable for comparison with the Fe line 2518 for this analysis, but nevertheless an accuracy of about ± 3% may be obtained. SE (9e)

METALLOGRAPHY (10)

J. S. MARSH, SECTION EDITOR

Upper Critical Temperature (Ac_3) of Steel as Affected by Various Elements, Robert R. Abbott. *Iron Age,* Vol. 132, Dec. 28, 1933, pages 7-9, (insert). From a paper read at joint meeting of Cleveland chapters of A.S.S.T. and S.A.E. Gives complete data regarding the elevation or depression of upper critical point as a result of usual additions to steel of C, P, S, Mn, Ni, and Si. Approximately 400 bars of steel were investigated from various manufacturers in U. S. and foreign countries. Samples included all varieties of steels obtainable. Notched bars were annealed slowly in Pb until microscopic examination showed pearlite structure. To find effect of different elements upon Ac_3, the experimental data were analyzed by method of least squares. The following represents final effects:

Ac_3 for pure Fe is 908°C. (first trace of C).
0.01% C lowers Ac_3 by 2.237°C
0.001% P raises Ac_3 by 0.4385°C.
0.01% Si raises Ac_3 by 0.3049°C.
0.01% V raises Ac_3 by 0.3792°C.
0.01% Mn lowers Ac_3 by 0.3443°C.
0.01% Ni lowers Ac_3 by 0.23°C. but increases it by 2 (C — 54 + 0.06 Ni) provided bracketed quantity is positive. VSP (10)

Preparation of Plane Surfaces by Dry Polishing and Grinding (Framställning av plana ytor medelst torrslipning, resp. torrpolering) C. Benedicks & P. E. Wretblad. *Jernkontorets Annaler,* Vol. 118, Feb. 1934, pages 45-77. Dry grinding and polishing is necessary in preparing plane surfaces for microscopic work when slag inclusions are present that might otherwise drop out. For this purpose a special machine was constructed provided with a lead disk with two spiral grooves for emery powder. With ordinary emery powder a surface was obtained which could readily be finished on wet cloth. With the very finest specially prepared powders, a polished surface was obtained. Extra hard nuclei, such as vanadium and titanium nitrides or tungsten carbides, may resist polishing and give rise to streaks in the surface which may be overcome by removing loose grinding powder, by avoiding too high pressures, and by turning at a high rate. By measuring the intensity of light reflection at various angles, the roughness of the surface may be determined, since a rough surface shows reflection over a wider range of positions. It was found that a cellulose-lacquer coating of emery powder on a glass disk gave a good grinding surface. Dust was removed by an adhesive roller, and surface oxidation was avoided by working in a nitrogen atmosphere. Details of the grinding machine are given in an appendix. 24 references. HCD (10)

Melting Surfaces in the System Aluminum-Aluminum Oxide-Aluminum Carbide (Ueber die Schmelzfläche im System Aluminium, Aluminiumoxyd, Aluminiumcarbid) Emil Baur & R. Brunner. *Zeitschrift für Elektrochemie,* Vol. 40, Mar. 1934, pages 154-158. Binary and ternary melts of this system were investigated and the melting points of the system $Al-Al_2O_3-Al_4C_3$ determined. Binary phases Al_8O_9 and Al_9C_3 were found. In the reduction of alumina by C, a melt of varying ternary composition exists below 2000°C; hence, the previously assumed quintuple point at which the phases Al (liquid), Al_2O_3 (solid), Al_4C_3 (solid), C, gas at 2013°C. and 1.5 atm. coexist must be denied, because all of these phases cannot exist at this temperature. Ha (10)

Nature of Secondary Heating. Its Effect and Practical Importance. S. A. Baranov. *Soobschenia Leningradskogo Instituta Metallov,* No. 13, 1933, pages 25-33. (In Russian) This investigation was carried out on Cr-Ni steel (C, 0.36%; Mn, 0.54%; Cr, 1.13%; Ni, 2.92%; S, 0.013%; P, 0.009%) which was melted in an electric furnace, forged, and annealed. By "secondary" heating, the author means a heating carried on from a temperature somewhat above Ar_3 point. Ar_3 transformation ($Fe\gamma \longrightarrow Fe\alpha$) was determined for this steel to be at 420°C. The author carried his "secondary" heatings from 500° and 600°C., the velocity of this heating being varied from about 0° to 10°C., and more, per min. 10°C. per min. was found for this steel to be a critical velocity. Thermal and dilatometric methods were employed. It was found that increased volume change of steel is inversely proportional to the rate of heating. When this rate is >10°C. per min., (critical rate for the steel investigated) no volume changes are observed, whereas at the low rate of heating ($\sim$ 0° per min.), volume changes reach their maximum values. The volume changes on secondary heating correspond to the transformations: $Fe\gamma \longrightarrow Fe\alpha \longrightarrow Fe\gamma$ The described phenomenon is based on the nature of undercooled austenite and its ability of aging. AIK (10)

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Condition of Flowing of Crystals (Zur Fliessbedingung von Kristallen) W. Boas & E. Schmid. *Zeitschrift für Physik,* Vol. 86, No. 11/12, 1933, pages 828-830. Recent investigations seem to solve the question of whether the elongation limit of crystals is determined at a constant shearing stress or at a constant elastic pushing effect in the translatory system, in favor of the shearing stress; tests were made on crystals of Ag, Au, α-β brass and Al-Cu alloy. The beginning of plasticity is, therefore, considered to be determined by the law of tension, not of deformation. Ha (10)

The Surface Tension of Liquid Metals. Part V. The Surface Tension of the Lead-Tin Alloys. L. L. Bircumshaw. *London, Edinburgh, & Dublin Philosophical Magazine & Journal of Science,* Vol. 17, Jan. 1934, pages 181-191. The surface tension of Pb-Sn alloys over the whole composition range, and from the freezing points to 800°C., decreases with rise of temperature. A relation to the lattice structure cannot be established definitely. 12 references. Ha (10)

X-Ray Study on Alloys of Silicon with Chromium, Manganese, Cobalt and Nickel (Röntgenuntersuchung der Legierungen von Silizium mit Chrom, Mangan, Kobalt und Nickel) Bertil Borén. *Arkiv för Kemi, Mineralogi och Geologi,* Vol. 11a, Apr. 12, 1933, 28 pages. There are 4 intermetallic compounds in the Cr-Si system: (1) Cr_3Si which crystallizes in the cubic system with an edge length of 4.555 A.U. (2) CrSi, analogous to FeSi, has an edge length of 4.620 A.U. (3) $CrSi_3$, belonging to the hexagonal system. The dimensions are $a = 4.422$ A.U., $c = 6.351$ A.U., $c/a = 1.44$. There are 9 atoms per unit cell. (4) A complicated phase of probably tetragonal form, stable below 1000°C. Three intermetallic phases were found in the Mn-Si system: (1) Mn_3Si, hexagonal, 16 atoms per unit cell, and $a = 6.898$ A.U., $c = 4.802$ A.U., $c/a = 0.696$. (2) MnSi, exhiting the same structure as FeSi and of cube edge of 4.548 A.U. (3) $MnSi_2$, not analogous to $FeSi_2$, tetragonal, and of the following dimensions: $a = 5.513$ A.U., $c = 17.422$ A.U., $c/a = 3.16$. The elementary cell has 48 atoms. Si does not hold Mn in solid solution. Only 2 intermediate phases were established in the Co-Si system: (1) Co_2Si belonging to the rhombic system, containing 12 atoms per unit cell of dimensions $a = 3.730$ A.U., $b = 4.908$ A.U., $c = 7.095$ A.U. (2) CoSi, structurally identical with FeSi. The length of its unit cube is 4.438 A.U. Cubic and hexagonal Co dissolve Si with lattice contraction. A partial study of the binary Ni-Si system revealed the presence of the compound NiSi, which corresponds to the FeSi structure and has a cube edge of 4.437 A.U. WH (10)

Metastability of Elements and Compounds Due to Enantiotropy or Monotropy XVIII. The Lead Oxide Problem (Die Metastabilität der Elemente und Verbindungen als Folge von Eantiontropie oder Monotropie. XVIII. Das Bleioxydproblem) Ernst Cohen & N. W. H. Addink. *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 168, Mar. 1934, pages 188-201. Density measurements with pycnometer and X-rays showed that red and yellow Pb oxide belong to the group of enantiotropic materials. The transition temperature is 488.5°C. Former difficulties met by various investigators are ascribed to the effect of solid-liquid interfacial tension heretofore unaccounted for in pycnometer density measurements. EF (10)

Metallographic Grinding with Paraffin Impregnated with Abrasives. R. L. Dowdell & M. J. Wahll. *Metals & Alloys,* Vol. 4, Nov. 1933, pages 181-182. The authors discuss the several methods employed by others to avoid the pitting of metallographic specimens when polished with a water suspension of the intermediate abrasives. The method of producing a paraffin bonded grinding wheel of the desired grade and abrasive is described. An automatic polishing machine using such disks is described. WLC (10)

Cementite-Free Boundaries in Quenched 1% C Steel. SKF Laboratories. *Metal Progress,* Vol. 24, Oct. 1933, page 49. Micrographs at 100 and 1000 x. WLC (10)

Electric Conductivity and Constitutional Diagrams of Binary Alloys. X. The System Magnesium-Bismuth (Elektrische Leitfähigkeit und Zustandsdiagram bei binären Legierungen. X. Das System Magnesium-Wismut) G. Grube, L. Mohr & R. Bornhak. *Zeitschrift für Elektrochemie,* Vol. 40, Mar. 1934, pages 143-150. Study of the Mg-Bi diagram confirms the existence of only the compound Mg_3Bi_2, but with a melting point of 823° instead of 715°C., as determined formerly; the latter temperature is that of the newly discovered $\alpha \rightleftarrows \beta$-transformation. The conductivity was determined for the whole range; there exist irregularities in the 30-35% Bi range, which cannot be explained. The microscopic examination of the alloys is described. 10 references.—**XI. The System Lithium-Magnesium (Das System Lithium-Magnesium)** G. Grube, H. v. Zeppelin & H. Bumm. *Zeitschrift für Elektrochemie,* Vol. 40, Mar. 1934, pages 160-164. The diagram was was developed and electric conductivity for the whole system in the range from 25° to 550° C. determined. A maximum melting point of 592° C. was found in the 28 to 30% Li range. The conductivity curves showed 6 discontinuities: at 15, 22, 60, 70, 75 and 80% Li at the resp. temperatures of 590, 595, 415, 318, 280, 258° C.; all marked passing through the solidus line except at 22% Li, where eutectic melting occurs. X-ray examination showed a hexagonal Mg lattice at 15% Li and a body-center-cubic lattice (as in pure Li) at 35 and 40% Li; the other alloys showed lines of both. The eutectic point is at 21.8% Li; at 587.5° C. a eutectic consisting of Mg solid solutions and phase Li_2Mg_5 crystallizes out. Ha (10)

The Magnesium-Antimony Diagram (Das Zustandsdiagramm Magnesium-Antimon) G. Grube & R. Bornhak. *Zeitschrift für Elektrochemie,* Vol. 40, Mar. 1934, pages 140-142. The Mg-Sb diagram was developed from thermal analysis; it is similar to the Mg-Bi diagram. 2 eutectic horizontal lines, at 629°C. on the Mg-side and at 579° on the Sb side, were observed; as these lines reach to the pure Mg and Sb resp. no formation of solid solutions occurs in this range. Eutectic points exist at 10% Sb and 86% Sb; the system contains only the compound Mg_3Sb_2, with the extraordinary high melting point 1228° C. An $\alpha \rightleftarrows \beta$ transformation of Mg_3Sb_2 was observed, between 40 and 44% Sb, on the cooling curves at $930 \pm 2°$ C. Mg-containing β-solid solutions of the compound disintegrate in cooling at 894° into melt D and solid solution F. The results are discussed and compared with other investigations. Ha (10)

Recrystallization of Iron Alloys with a Closed γ-Field at the A_3 and A_4 Point (Die Umkristallisation von Eisenlegierungen mit geschlossenem γ-Field beim A_3- und A_4-Punkt) A. Heinzel. *Archiv für das Eisenhüttenwesen,* Vol. 7, Feb. 1934, pages 479-482. The structure of Fe alloys with varying contents of Al, Ti, V, and W, were studied on heating through the A_4 temperature range. At about 4/5 of the concentration of the respective alloying elements at which the γ loop closes, a refinement of the grain no longer occurred on heating through the A_4 range, only grain growth. The relation of the above to α-veining, which is shown to occur in some of these alloys, is discussed. SE (10)

Artificial Transformation of Magnesium by Polonium-α-Particles (Die künstliche Umwandlung des Magnesiums durch Polonium-α-Teilchen) H. Klarmann. *Zeitschrift für Physik,* Vol. 87, No. 7/8, 1934, pages 411-424. Bombardment of Mg by Po α-particles ejects protons, which consist of 4 distinct groups. Method of counting the protons and their distance of travel in air (about 3.8 cm.) is described. Ha (10)

Selective Etching Reagent for Copper and Its Alloys. John B. Kasey. *Metal Industry,* N. Y., Vol. 31, Sept. 1933, page 306. A suggested etchant is ammonia water (sp. gr. 0.9) 15 cc., carbon tetrachloride 15 cc., alcohol 95%, 45 cc. Copper is readily dissolved. PRK (10)

Inclusions within Inclusions. Albert Portevin. *Metal Progress,* Vol. 25, Jan. 1934, pages 42-43. Reports the finding of metallic inclusions in the center of non-metallic inclusions. Micrographs show such metallic inclusions in a complex Cr silicate inclusion in 30% Cr steel. This occurrence provides striking proof of mutual solubilities of metal and slag and their precipitation one from the other. WLC (10)

Local Formation of Martensite in Steel Wire (Oertliche Martensitbildung bei Stahldraht) Anton Pomp. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Düsseldorf, Vol. 16, No. 2, 1934, pages 15-19. A little-observed defect of cold-drawn steel wire, characterized by hard spots on the surface, is described. They have a martensitic structure and are formed, as experiments demonstrated, by high local heating, e.g. friction, and rapid cooling by the surrounding cold material. Ha (10)

A Precision, High Power Metallographic Apparatus. Francis F. Lucas. *Metal Progress,* Vol. 24, Oct. 1933, pages 21-25. Special features of a microscope and camera for attaining increased resolution and magnification are described. A mercury-vapor-lamp train providing practically monochromatic light, a mono-brom-naphthalene objective of N.A. 1.60, corrected for the blue regions of the visible spectrum, and special plates of increased sensitivity to the light employed are features of the setup. Massive camera supports, provided with protection against mechanical disturbances, permit exposures of 30 min. duration at magnifications of 4000x. WLC (10)

Formation of Graphite in Cast Iron and Its Importance for the Production of High-quality Gray-Iron (Die Graphitbildung im Gusseisen und ihre Bedeutung für die Herstellung von hochwertigem Grauguss) A. Loebner. *Die Giesserei,* Vol. 21, Apr. 13, 1934, pages 156-158. Present views on formation of graphite and its influence on quality of cast Fe are discussed. The aim is to produce material with high content of pearlitic structure, which increases tensile strength; it contains about 1% C and melts at 1460 to 1500°C. Mn has no great influence, but Si must be adjusted according to wall thickness and to C content. Ha (10)

Surface Grating Interference with Electron Rays on Thin Silver Foils (Flächengitterinterferenzen mit Elektronenstrahlen an dünnen Silberschichten) Hans Lassen. *Physikalische Zeitschrift,* Vol. 35, Feb. 15, 1934, pages 172-174. Silver foils prepared according to Rupp's method were investigated with electron rays; this usually gave a normal Debye-Scherrer ring, but in the present test there also appeared a new diffraction pattern that was similar to surface-grating figures. The author describes the apparatus and gives photographs showing the rings and the grating image, which he compares with a calculated surface-grating-interference figure for a silver crystal. RRS (10)

X-Ray Studies on the Nickel-chromium System. E. R. Jette, H. Nordstrom, B. Queneau & F. Foote. *Iron & Coal Trades Review,* Vol. 128, Mar. 16, 1934, page 445. See *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 153. Ha (10)

Physical Properties and Structure of Binary-System Iron-Cobalt. (Physikalische Eigenschaften und Struktur des Zweistoffsystems Eisen-Kobalt) A. Kussmann, B. Scharnow & A. Schulze. *Wissenschaftliche Abhandlungen der Physikalisch-Technischen Reichsanstalt, Berlin,* Vol. 16, No. 2, 1933, pages 437-448. See *Metals & Alloys,* Vol. 4, Dec. 1933, page MA 378. EF (10)

Equilibrium of Ions in Iron Solutions under Hydrogen Pressure. Kwanji Murata. *Journal Society of Chemical Industry, Japan,* Vol. 36, Apr. 1933, pages 160B-161B. The fundamental correlation reactions of Fe under pressure of H and the interdependence of ferrous ion-ferric-ion-H ion-hydroxyl ion-H equilibrium, in the presence or absence of Fe, are discussed from the thermodynamic standpoint. MAB (10)

Metallographic Investigation of Electrically Welded Tool Steels (Metallkundliche Betrachtung elektrisch gewschweisster Werkzeugstähle) A. Merz & R. Eschelbach. *Die Elektroschweissung,* Vol. 5, Mar. 1934, pages 41-45. For the tests described, fusion welded pieces of (1) drill-steel rods, (2) chisel-steel rods, (3) high-speed-steel rods, and (4) straight-C-steel rods were used. The welds examined comprised joints of drill steel with drill steel, drill steel with straight-C steel, chisel steel with chisel steel, chisel steel with C steel, high-speed steel with high-speed steel, and high-speed steel with C steel. Joints were made both manually and with an automatic-welding machine. Results of manually made seams: (1) Oxidic inclusions were found in 60% of the seams, (2) annealing time required for transforming weld structure to a normal-annealing structure could not be predetermined, (3) superheated structure may easily result owing to personal performance of welding process, (4) presence of oxides may cause decarburization in subsequent heat treatment. Mechanically made seams: (1) In all samples examined no oxide inclusions were observed, (2) shrinkage cracks on both sides of seam could not occur on account of automatic control of upsetting or by a device for eliminating formation of stresses, (3) zone of changed structure in seam on account of welding was much smaller in mechanically than in manually made seams, (4) structure of seam shows no indication of excessive heat or too long welding time, (5) fin formed upon upsetting was uniform on all sides of seam, thus indicating uniform heating throughout cross-section and correct upsetting pressure, (6) initial structure of rods as delivered could be regenerated easily. In every respect automatic welding is far superior to manual welding. GN (10)

An Investigation on Some Magnesium Alloys. Shiro Ichida. *Japanese Journal of Engineering,* Abstracts Vol. 9, 1933, page 68. A study of some equilibrium diagrams by thermal analyses and microscopic investigations. Limit of solubility of Al in Mg was found to be about 5% at ordinary temperatures and 13% at the eutectic temperature. The solubility of Zn in Mg was observed to be about 3% at 200°C. and 7% at 300°C. The alloy containing 55% Zn showed a curious phenomenon. It solidified as a white solid solution but transformed a few degrees below the crystallization temperature into a eutectic structure. A ternary compound was found in the Mg-Zn-Cu system and in the Mg-Cu-Al system, but their formulas were not determined. Melting experiments showed that Mg manufactured by electrolysis of Mg oxide could be melted without a flux, but carnalite (+ rock salt) flux should be employed in case of Mg prepared by electrolysis of Mg chloride. WH (10)

Transformation of Austenite (Hardening under Pressure) (Ueber die Umwandlung des Austenits [Härtung unter Druck]) Herbert Mueller. *Zeitschrift für Physik,* Vol. 86, No. 7/8, 1933, pages 532-536. Samples of ordinary C-steels were quenched under pressure; they showed a strong formation of glide lines, upon which an amount of troostite occurs which increases with increasing pressure. The same formation was observed also at the grain boundaries. Grain boundaries and glide lines are areas of least resistance at which the austenite transformation is accelerated, as the formation of troostite proves. Since, with increasing pressure, the formation of glide areas increases, it seems not possible to produce pure austenite in this manner; however, the formation of glide areas can be suppressed by isotropic pressure. Ha (10)

X-Ray Studies of Aluminum-Zinc Alloys. E. A. Owen & John Iball. *London, Edinburgh, & Dublin Philosophical Magazine & Journal of Science,* Vol. 17, Feb. 1934, pages 433-457. The Al-Zn system was studied by the powder method; only alloys below the eutectic-transformation temperature could be investigated by quenching from the desired temperature. At 250°C. the system consists of the following regions: 1. α-phase (close-packed hexagonal structure) in alloys containing less than 2% Al by wt.; 2. $(\alpha + \gamma)$ region extending from 2% to 80% Al; 3. γ-phase (face-centered cubic structure) in alloys containing more than 80% Al. Transformation temperature lies between 300° and 310°C. The β-phase is a solid solution with a face-centered-cubic structure; it extends, at 375°C., from 19-45% Al. In the $(\beta + \gamma)$ region, 2 face-centered-cubic lattices of different parameters coexist. 7 references. Ha (10)

Heat of Formation of the Iron Carbide Fe_3C (Die Bildungswärme des Eisenkarbids Fe_3C) Gerhard Naeser. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Düsseldorf, Vol. 16, No. 1, 1934, pages 1-7. A review of measurements of heat of formation of Fe_3C shows varied values between positive and negative limits. It was again determined from amorphous C and α-iron at room temperature by converting the carbide (under separation of C) and the pure Fe into the iodide and chloride resp. From both methods the heat of formation was found to be $+ 8 \pm 0.25$ kcal./mol., which corresponds to 44.6 ± 1.4 cal./g. for cementite, 47.8 ± 1.5 cal./g. for Fe, 668 ± 20 cal./g. for C. The heat of combustion of finely distributed amorphous C from disintegration of carbide was found to 107.9 kcal./mol. The heat of formation of FeS, from α-Fe and rhombic S, is 23.89 ± 1.16 kcal./mol. The final result is that the heat of formation of Fe_3C lies in the range of +8 to —4 kcal./mol., according to the state of C; it decreases with increasing graphitization. 46 references. Ha (10)

Coarse-grained Recrystallization of Steel with High Content of Carbon (Ueber grobkörnige Rekristallisation hochkohlenstoffhaltigen Stahles) Anton Pomp. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Düsseldorf, Vol. 16, No. 2, 1934, pages 9-13. Tests with a steel of 1.2% C showed that, as in low C steel, a critical range of deformation exists between 5 and 15% reduction of section where a pronounced coarsening of grain takes place, connected with distinct changes of mechanical properties; in particular of proportionality limit and elastic limit; notch-toughness is not deteriorated. Drawing tests showed that the resistance to deformation decreases with increasing coarseness of grain. Condition for occurrence of coarse-grained recrystallization in high C steel is besides deformation between 5 and 15%, a structure of ferrite and spheroidal cementite and annealing temperature below Ac_1. 8 references. Ha (10)

The Effect of Al and Co on the Miscibility Gap of Fe and Cu in the Solid State (Zum Einfluss des Al und Co auf die Mischungslücke von Fe und Cu im festen Zustand) F. Roll. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 216, Dec. 29, 1933, pages 133-137. Ni and Mn increase solubility of Cu in Fe considerably, Co only moderately. The investigation of the solubility of different elements in the system Fe-Cu shows that all those elements which can form series of solid solutions in the binary system Fe-X and Cu-X. are particularly apt to reduce the miscibility gap in the system Fe-Cu-X. Since a wide gap in the solid solutions of the binary systems Cu-Co exists, it reduces the miscibility gap in the Cu-Fe alloys less than Ni or Mn. Al, Sn, Sb, and P have only small influence on the reduction of the Cu-Fe gap. Ha (10)

The Personality of Steel. G. R. Brophy. *General Electric Review,* Vol. 36. Dec. 1933, pages 529-538. Two steels of identical composition may have totally different physical properties. Normal steel shows laminated pearlite with excess cementite as a thin complete envelope while abnormal steel shows the carbide agglomerated to large masses leaving areas of carbide-free Fe. Recent studies on the causes of normality and abnormality are reviewed. The primary factor in the production of normality is grain size, which is controlled by the presence or absence of grain growth inhibitors. Effects of heat treatments and cold working are discussed. CBJ (10)

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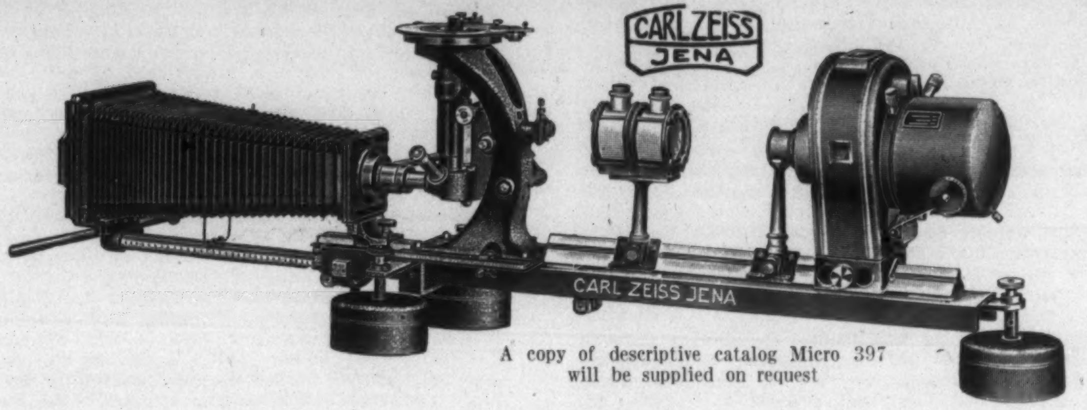

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Lowering of the Eutectic Temperature in Iron-Carbon Alloys (Die Verlagerung der eutektischen Temperatur in Eisen-Kohlenstoff-Legierungen) E. Piwowarsky. *Stahl und Eisen,* Vol. 54, Jan. 25, 1934, pages 82-84. Accurate determinations of time-temperature curves in iron-carbon alloys confirmed the observations of Ruer, F. Goerens, and of P. Goerens, that on repeated remelting the cementite eutectic-arrest gradually disappears, and is replaced by the graphite eutectic arrest. Raising the superheating temperature lowered the eutectic temperature; decreasing the C content raised it. Cooling cast iron directly after Si or Mn additions lowered the eutectic point, but this effect disappeared on holding after the additions. However, Ni always lowered the eutectic point. Mo was intermediate between Ni and Si or Mn in this respect. SE (10)

Particle Size Determination with Electron Rays (Über Teilchengrössenbestimmung mit Elektronenstrahlen) Rudolf Brill. *Zeitschrift für Kristallographie,* Vol. 87, Feb. 1934, pages 275-280. A relationship between width of electron diffraction rings and size (and shape) of the crystals under test is derived. The relationship coincides with the equation given for X-ray determinations by Scherrer with reference to cubic crystals whereby the assumption is made that the interference function $f(A_1)$ holds also for high-speed electrons. EF (10)

X-ray Analysis of the Iron-boron, Cobalt-boron and Nickel-boron Systems (Röntgenanalyse der Systeme Eisen-Bor, Kobalt-Bor und Nickel-Bor) T. Bjurström. *Arkiv för Kemi, Mineralogi och Geologi,* Vol. 11a, Mar. 1933, 12 pages. (In German.) X-ray analysis of the binary Fe-B, Co-B and Ni-B alloys in the concentration range of 0-20% B established the existence of the following phases: Fe_2B, FeB, Co_2B and CoB. In the Ni-B diagram the phase Ni_2B was found and several other intermediary phases. Fe_2B, Co_2B and Ni_2B crystallize body-centered tetragonal with 4 molecules to the elementary unit:

	Fe_2B	Co_2B	Ni_2B
a_1	5.099 A. U.	5.006 A. U.	4.980 A. U.
a_2	4.240 A. U.	4.212 A. U.	4.236 A. U.

All three phases belong to the space type $D^1{}_4{}^8{}_h$. FeB and CoB are rhombohedral according to the group $V^1{}_h{}^6$ with the following lattice dimensions:

	FeB	CoB
a_1	4.053 A. U.	3.948 A. U.
a_2	5.495 A. U.	5.243 A. U.
a_3	2.946 A. U.	3.037 A. U.

There are 4 FeB's and 4 CoB's to the unit cell. The radius of the B atom in the different phases yielded 0.97, 0.94, 0.92, 0.89, 0.93 in respectively Fe_2B, Co_2B, Ni_2B, FeB, CoB. WH (10)

The Micro-optical Investigation of Iron and Steel by Polarised Light. N. Ahmad & M. F. Schwarz. *Metallurgia,* Vol. 9, Dec. 1933, pages 33-37; Jan. 1934, pages 77-80. The apparatus used is briefly described. Samples must be polished free from scratches, but long polishing must be avoided as it produces relief structures that interfere with polarization phenomena. The samples may or may not be etched. Many of the effects observed cannot be ascribed to polarization phenomena, but they can be best observed with polarized light. Pearlite in certain orientations appears very bright with crossed nicols. Slip bands can be brought out sharply with crossed nicols, and internal stresses can be detected. The detection of internal stresses depends on the influences of the stresses on the etching attack. The several forms of iron oxide can be differentiated with polarized light, other inclusions can be identified, and the structure of graphite in cast iron can be observed. Flow lines found in such materials as cold-headed bolts can be followed. Constituents in Fe-W, Fe-Mo, and other Fe alloys can be identified. Many micrographs obtained with both parallel and crossed nicols are shown. 24 references. JLG (10)

Structure and Gas Content of Layers of Nickel produced by Cathodic Atomization (Ueber die Struktur und den Gasgehalt von Nickelschichten, die durch kathodische Zerstäubung hergestellt sind) W. Buessem & Fried. Gross. *Zeitschrift für Physik,* Vol. 87, No. 11/12, 1934, pages 778-799. Layers of Ni produced by cathodic atomizing have hexagonal structure I with an axial ratio $c/a = 1.63$; if heated to 400°C., the structure becomes cubic. Layers atomized in N contain always a mixture of N and H, the ratio of metal to gas atoms being about 1:1. The layer contains a face-centered-tetragonal constituent, $c/a = 1.315$, which has the character of compound NiNH. The phases change with temperature and also with purity of the N. 23 references. Ha (10)

Electric Conductivity and State Diagrams of Binary Alloys: The System Lithium-Bismuth (Elektrische Leitfähigkeit und Zustandsdiagramm in binären Legierungen; das System Lithium-Wismut) G. Grube, H. Vosskuehler & H. Schlecht. *Zeitschrift für Elektrochemie,* Vol. 40, May 1934, pages 270-274. The complete Li-Bi diagram was developed by thermal analysis and measurement of electric conductivity. At 1145°C., the compound Li_3Bi is formed. Compound LiBi is formed by peritectic reaction, and exists in 2 polymorphic forms; the transformation temperature lies at 400°C. Ranges of solid solution could not be found. Ha (10)

An Apparatus for the Thermal Analysis of Alloys Containing a Segregating Constituent. R. J. M. Payne. *Journal of Scientific Instruments,* Vol. 11, Mar. 1934, pages 90-92. By rotating about its own horizontal axis a crucible containing the alloy, the thermal analysis of which is required, inhomogenity of the alloy due to gravity is reduced. An apparatus for making temperature observations on a rotating sample is described. It is particularly suitable for use with magnesium alloys and typical curves obtained from such alloys are given. RAW (10)

Ternary Alloys Magnesium-Calcium-Zinc (Alliages ternaires Magnésium-Calcium-Zinc) R. Paris. *Usine,* Vol. 43, Mar. 29, 1934, page 31. The complete diagram of the system Mg-Ca-Zn was developed. The alloys can be classed in 3 groups: Alloys rich in Ca ($>$30%); they oxidize and disintegrate easily in humid air. Alloys rich in Zn ($>$40%); they oxidize little but are brittle, hard, and difficult to machine. Alloys rich in Mg; they are light, oxidize little and are easily machined; the range of solid solution at ordinary temperature is less than 1% Zn and Ca. Ha (10)

The Thermal Expansion of the Crystal Lattices of Silver, Platinum and Zinc. E. A. Owen & E. L. Yates. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 17, Jan. 1934, pages 113-131. Thermal expansion of Ag, Pt, and Zn was studied with a high-temperature precision X-ray camera, the specimens being heated in a vacuum up to 600°C. It is concluded from the experiments that in general the thermal expansion of the crystal lattice of these metals is the same as that of the material taken as a whole. 8 references. Ha (10)

X-ray Study of the Action of Aluminum during Nitride Hardening. John T. Norton. *Metals Technology,* Apr. 1934, *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 550, 9 pages. Powders were prepared from Fe-Al alloys containing as much as 10 per cent Al. These were nitrided to different N contents and lattice parameters determined with a Phragmén camera. The results showed that AlN was formed on nitriding and that Al was removed from solid solution in the Fe. When Fe nitrides were formed their parameters were not influenced by Al. AlN therefore forms during nitriding and the hardness of nitrided steels containing Al can be attributed to the formation of this nitride in a dispersed form throughout the Fe matrix. JLG(10)

Precision Measurement of the Lattice Constant of Face-centered-cubic β-Tungsten (Präzisionsmessung der Gitterkonstante von kubisch-raumzentriertem β-Wolfram) M. C. Neuburger. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 217, Mar. 24, 1934, pages 154-156. Parameters of the 2 modifications of W were determined to be: α-W, 5.038 ± 0.003; β-W, 3.1589 ± 0.0004 A.U. Ha (10)

PROPERTIES OF METALS & ALLOYS (11)

Nickel and Its Alloys. W. R. Barclay. *Metal Industry*, London, Vol. 44, Feb. 9, 1934, pages 155-159. With discussion. A brief survey of development of Ni alloys in the last 10 years; ternary Cu-Ni alloys, Ni-Cr alloys and Ni in austenitic steels is discussed, methods of production and fields of application on account of their special resistance to corrosion described. Ha (11)

Solubility of Hydrogen in Some Metals and Alloys (Löslichkeit von Wasserstoff in einigen Metallen und Legierungen) L. Luckemeyer-Hasse & H. Schenck. *Technische Mitteilungen Krupp*, No. 4, Dec. 1933, pages 121-126. See *Metals & Alloys*, Vol. 4, Oct. 1933, page MA 334. Ha (11)

Electrical Resistance and Heat in Metals. Charles R. Underhill. *Journal Franklin Institute*, Vol. 216, Nov. 1933, pages 629-634. The writer outlines an approximate method for determining electrical resistance stored up in metals at varying temperatures DTR (11)

Adsorption of Carbon Dioxide and Hydrogen on Bare and Oxygen-covered Silver Surfaces. Leonard C. Drake & Arthur F. Benton. *Journal American Chemical Society*, Vol. 56, Mar. 1934, pages 506-511. Results show that surfaces of free Ag and O-covered surfaces adsorb H only slightly. On the former CO_2 shows only physical adsorption; on the latter, physical or chemical. If the surface is coated with oxide of Ag, the CO_2 may also form Ag carbonate. It has been possible definitely to distinguish these several processes and to measure their equilibria or rates. MEH (11)

Compilation of Important Specific Heats for Metallurgical Calculations (Zusammenstellung wichtiger spezifischer Wärmer für metallurgische Berechnungen) C. Schwarz. *Archiv für das Eisenhüttenwesen*, Vol. 7, Nov. 1933, pages 281-292. Values for the specific heats and heat contents of 9 gases, 15 metals, and 19 oxides of importance in metallurgical calculations are given. SE (11)

The Deformation and Fracture Mechanism of the Metals (Metallernas Deformation och Brott Mechanism) C. H. Johansson. *Teknisk Tidskrift*, Vol. 64, Feb. 17, 1934, pages 13-18. Principally a review and discussion of the work done during the last decade in connection with plasticity and deformation theories, by studying the tensile properties of single crystals, and comparing the results with those obtained by macroscopic methods. A large list of literature references referring to the subject has been included. The effect of tensile properties of single crystals has also been applied in the study of fatigue phenomena. BHS (11)

Non-Conducting Metal Modifications (Ueber nichtleitende Metallmodifikationen) Johannes Kramer. *Annalen der Physik*, Series 5, Vol. 19, Jan. 1934, pages 37-64. Starting from the assumption that metallic conductivity is based on the existence of freely movable electrons and positive ions and that a non-ionized metal vapor is a perfect non-conductor it was concluded that by condensation of a non-ionized vapor non-conducting metallic layers should be obtained. By cathodic atomization and by volatilization metallic modifications were obtained which had a 10^6 times lower electric conductivity than the normal metal. Layers of 10^{-4} cm. were made of Fe, Ni, Pt, Zn, Sn, Cd and Sb. At a certain temperature characteristic of each metal the low conductivity suddenly increases to almost normal value; the critical temperature has a relation to the normal conductivity, a formula is given. This modification of the metal is an amorphous phase which exists for all metals below the transformation temperature at certain atomic structures. Ha (11)

Non-Ferrous (11a)

A. J. PHILLIPS, SECTION EDITOR

Special Alloys (Speziallegierungen) *Zeitschrift für die gesamte Giessereipraxis*, Vol. 54, Nov. 12, 1933, page 474; Dec. 24, 1933, page 534; Vol. 55, Jan. 7, 1934, page 16; Feb. 2, 1934, page 56; Feb. 18, 1934, page 78. Composition, properties and application of Durand metal (Al-Zn alloy with 33% Zn), Duranik (corrosion resistant Al alloy with 4% Ni, 2% Mn), Durex bearing metal (Cu-Zn bronzes containing graphite) and Edward's speculum (Zn and As bearing bronze) are described. Duranametal, an Al, Sn, Sb and Fe bearing brass, possesses good casting and tensile properties also distinguished by high corrosion stability. Dysiot bearing metal containing 62% Cu, 10% Sn, 10% Zn and 18% Pb, Eel antifriction metal with 75% Pb, 15% Sb, 6% Sn, 1.5% Cd, .5% As, .1% P is claimed to be harder than common antifriction metal but otherwise not distinguished by better properties than common antifriction metal. Standard bearing metal with 80% Pb, 15% Sb and 5% Sn as the corresponding English alloy Magnolia finds extensive use in Germany for locomotive and freight car bearings. Composition, properties and application of iron bronze, Eisler's bronze (a bronze with 5.9% Sn for art castings) elephant bronze (95% Cu, 10.5% Sn, 2.75% Zn, 1.5% Pb, .1-.2% P), Elektrum (a normal German silver alloy with 51.6% Cu, 22.6% Zn, 25.8% Ni) elephant- S- bronze an American "plastic" bearing bronze with 80.5% Cu, 10.2% Sn, 9% Pb, .1-.3% P, Elinvar, Elmarid (a W hard metal alloy with 83% W, 5.9% C, 4.5% Co, .4% Fe), Emerald bronze an Al bearing Zn rich brass alloy containing on the average 50% Cu, 49.6% Zn and .4% Al are discussed. GN (11a)

Thermal Measurements on Heat Treated Aluminum Alloys. (Thermische Messungen an vergütbaren Aluminiumlegierungen.) W. Fraenkel. *Metallwirtschaft*, Vol. 12, Oct. 13, 1933, pages 583-585. The alloys contained (1) 4% Cu, (2) 4% Cu and .5% Mg, (3) 4% Cu, .5% Mg, and .5% Mn. One alloy rod and one pure Al rod, each insulated with asbestos, were carefully placed in an electric furnace so that they would heat up at the same rate. One thermocouple registered the temperature of the alloy bar and another the difference in temperature between the two bars. The furnace was heated at the rate of about 12° C. per minute up to the melting point of the alloy. The samples had all been quenched from 500°, and some were tested immediately, others aged. The differential curves show a maximum near 250°, a pronounced minimum at 310° to 360° corresponding to precipitation, and two maxima at about 400° and 490°. The amount of precipitation indicated by the curves is greater in the aged than in the freshly quenched condition. Apparently no precipitation takes place during aging. In the Mg free alloy the various points occur at higher temperatures than in the other two alloys. There is less variation in the curves between the three alloys than between the same alloy with various treatments. CEM (11a)

Thermal Expansion of Manganin (Ueber die thermische Ausdehnung des Manganins) A. Schulze. *Wissenschaftliche Abhandlungen der Physikalisch-Technischen Reichsanstalt*, Berlin, Vol. 16, No. 2, 1933, page 476. See *Metals & Alloys*, Vol. 4, Oct. 1933, page MA 308. EF (11a)

Iron in Bronze and Brass Alloys (Die Stellung des Eisens in Bronze-und-Messinglegierungen) Edmund R. Thews. *Zeitschrift für die gesamte Giessereipraxis*, Vol. 54, Dec. 24, 1933, pages 532-534. Iron in bronze and brass may improve as well as impair their properties when properly alloyed and cast. Mechanical and chemical properties of most of the bronzes and brasses are favorably affected by certain amounts of Fe. In other cases, however, Fe detrimentally affects the properties, in particular the cutting properties. Even small amounts of Fe are sufficient to bring this about. This is due to the formation of carbides. For this reason, in melting these alloys melt should not be covered with coke for protection against oxidation. Therefore, high quality bronzes and brasses should not be melted in graphite crucibles but in MgO crucibles. As protective slag glass and calcined soda is best used. To decompose small amounts of carbides formed in Cu alloy melts 2 methods are used either by forming a special slag or treating with $HgCl_2$. Both of the methods are described but author rejects usefulness of latter method. GN (11a)

Magnesium Alloys. Leslie Aitchison. *Mechanical World & Engineering Record*, Vol. 95, Feb. 9, 1934, pages 117-118; Feb. 16, 1934, pages 148-149. Comparison of the properties of pure Mg, Al and Cu. The fact that Mg crystallizes in the hexagonal system has a big bearing upon the mechanical and metallographic behaviour of Mg and upon the subject of alloying. Data showing the influence of different proportions of Zn and Cd (which crystallizes in the same system) upon the properties of Mg are given in tables, but it is necessary to produce ternary alloys to gain materials with useful mechanical properties. The effects of additions of Al, Mn, Si and Al plus Zn to Mg are discussed and presented in tables. To compare mechanical properties of Al alloys and Mg alloys "as cast," these are tabulated. In a general sense the mechanical properties of alloys of Mg are not capable of improvement by heat treatment in the same way as occurs with duralumin or its derived alloys. The possibility of applying cold work to Mg alloys, particularly to those containing any notably high proportion of alloying elements, is slight, but at temperatures over 225°C. the capacity of Mg and its alloys to suffer distortion increases considerably. Mechanical properties of representative Mg alloys in a variety of forms produced by working hot are shown in tables. Referring to the properties of Al alloys as comparison, fatigue values at room temperatures and tensile strengths at elevated temperatures of various wrought alloys of Al and of Mg alloys are discussed and presented in tables. In conclusion the author deals with ratio of modulus of elasticity to density of Fe, Al and Mg. Kz (11a)

The Supraconductivity of Alloy Systems. J. F. Allen. *London, Edinburgh, & Dublin Philosophical Magazine and Journal of Science*, Ser. 7, Vol. 16, Nov. 1933, pages 1005-1044. 12 references. Supraconductivity of 7 alloy systems: Au-Sn, Au-Pb, Ag-Sn, Ag-Pb, Cu-Sn, Cu-Pb, and Tl-Sn, was examined. Different supraconductive characteristics were found for each of 3 structural types. (1) Simple eutectic mixtures, show constant supraconductivity point except in the neighborhood of the boundaries. (2) Simple solid solutions, show a continuously varying supraconducting point and transition interval. The latter was found to be least at the phase boundaries and greatest in the middle of the phase. (3) A double series of solid solutions, show similar supraconductive characteristics to the second type. This third type, found in the Tl-Sn system, upon X-ray examination shows that the transition temperature varies inversely with the magnitude of the lattice constants. In all types of structure the supraconductivity curve was found to be a continuous function of the concentration. From the results obtained it is impossible to say definitely whether Au, Ag or Cu would be supraconductive at temperatures below 1°K. RHP (11a)

Very Light Magnesium-Aluminum-Copper Alloys (Etude des alliages ultra-legers magnesium-aluminium-cuivre). Paul Bastien. *Revue de Metallurgie*, Vol. 30, Nov. 1933, pages 478-501; Dec. 1933, pages 528-542. Thermal analysis of Mg rich Al-Cu alloys showed the existence of a liquidus containing four primary areas corresponding to the separation of Mg, Mg_4Al_3, Mg_2Cu and $Mg_2Cu_3Al_2$ phases, of two ternary eutectics melting respectively at 412°C. and 484°C. and of two ternary solid solutions one rich in Mg, the other in Mg_4Al_3. Metallographic examination supported the above. Hardness and coefficient of dilatation were determined for machinable alloys ($Al + Cu = 15\%$ max). The limit of solid solubility in ternary alloys is sharply marked by precipitation of Mg_4Al_3. Determinations of specific gravity and electric conductivity definitely established the limits of solid solubility. These alloys containing as much as 12% Cu can be forged improving their mechanical properties without affecting lightness or conductivity. Mechanical properties of industrially interesting alloys ($Al + Cu = 15\%$ max) were determined in detail. For cast alloys tensile testing should be replaced by static flexion, as being more precise. Some alloys are as strong as Electron metals, some others have rotating beam fatigue strength of duralumin, 12-13 kg./mm^2. Addition of Cu to alloys with the same content of Al slowly increases their corrodibility in acid solutions, and very rapidly in saline solutions. Addition of Al to Mg-Cu alloys rapidly reduces their corrodibility in sea water. Starting with 3% Al average corrosion rate of ternary alloys becomes of the same order. JDG (11a)

Formation of Metal Carbides of Very High Melting Point by a Red-hot Carbon Filament in the Vapor of a Volatile Halogen Compound of the Metal (Ueber die Bildung hochschmelzender Metallkarbide beim Glühen eines Kohlenfadens im Dampf einer flüchtigen Halogenverbindung des Metalls) W. G. Burgers & J. C. M. Basart. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 216, Jan. 26, 1934, pages 209-222. The carbides TiC, ZrC, TaC and Ta_2C were obtained when bringing a carbon filament to 2500°C. in the vapors of $TiCl_4$, $ZrCl_4$ and $TaCl_5$ resp. The lattice constants of the carbides were determined as:

TiC	$a = 4.320 \pm 0.001$A. U.	
ZrC (cubic face-centered)	$a = 4.687 \pm 0.002$A. U.	
TaC	$a = 4.445 \pm 0.001$A. U.	
Ta_2C metal atoms hexagonal close-packed	$a = 3.091 \pm 0.001$A. U. $c = 4.93 \pm 0.007$A. U.	$c:a = 1.595$

Ha (11a)

Properties of the Alloys of Nickel with Tantalum. E. Therkelsen. *Metal Industry*, London, Vol. 43, Aug. 25, 1933, pages 175-178. See *Metals & Alloys*, Vol. 5, Feb. 1934, page MA 38. Ha (11a)

Age Hardening Nickel Bearing Aluminum Alloys (Aushärtbare nickelhaltige Aluminiumlegierungen) B. Trautmann. *Deutsche Motorzeitschrift*, Vol. 10, Nov. 1933, pages 216-222. Full reports on melting and casting, heat treatment, physical properties and utilization of age-hardenable Ni-bearing Al alloys of the following composition:

Trade Mark	Cu	Ni	Mg	Fe	Si	Ti	Al
Y	4.00	2.00	1.50	....	....	....	bal.
RR50	1.30	1.30	0.10	1.00	2.20	0.18	bal.
RR53	2.25	1.30	1.60	1.40	1.25	0.10	bal.
RR56	2.00	1.30	0.80	1.40	0.70	0.10	bal.
RR59	2.25	1.30	1.60	1.40	0.50	0.10	bal.

Besides good chill and sand casting properties, forging is feasible with alloy Y. Si in RR50 improves casting properties. Ti conteracts oxidation. The alloys are quenched from 500-540° C. and aged at 100-175° C. Gain in strength due to precipitation hardening amounts to 35-40%. The specific weight of the Y alloy is 2.80 and of the RR types between 2.10 and 2.75. Utilization: pistons, connecting rods, cylinder heads, propellers, crank cases. Tests of the London & North Eastern Railway Co. with forged valves and connecting rods yielded good results during a 1 year operation. The savings in weight for these parts were respectively 20% and 50% as compared with steel previously employed. EF (11a)

Problem of Electrical Conductivity in Synthetic Metallic Bodies (Zur Frage der elektrischen Leitfähigkeit synthetischer Metallkörper) W. Trzebiatowski. *Zeitschrift für physikalische Chemie*, Abt. B, Vol. 24, Jan. 1934, pages 87-97. In comparison with solid metals, synthetic metallic bodies made up by pressed powder exhibit electric conductivity anomalies. Compressed bodies of Cu and Au powder were studied between 18° and 600° C. The strange course of the temperature/resistance curve is due to absorbed gas layers and recrystallization phenomena. This was corroborated by dilatometric measurements. A remarkable analogy to the behavior of metallic films was thus established. The existing theory of Zenji Nishiyama (*Zeitschrift für Physik*, Vol. 71, 1931, page 606) on electric conductivity of synthetic metallic bodies is refuted. EF (11a)

Dia- and Paramagnetism in Series of Metallic Solid Solutions, II and III (Zum Dia- und Paramagnetismus in metallischen Mischkristallreihen) Eckhart Vogt & Hans Krueger. *Annalen der Physik*, Series 5, Vol. 18, Dec. 1933, pages 755-790. The magnetic susceptibility of solid solutions in the systems Au-Ni, Cu-Pd and Cu-Pt was investigated and the influence of structure determined. Results are shown in curves. Ha (11a)

A New Lead Alloy. W. Singleton & Brinley Jones. *Gas Journal,* Vol. 202, May 3, 1933, page 270. See "Some Effects of the Addition of Tellurium to Lead," *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 335. MAB (11a)

Influence of Silver on the Softening of Cold-worked Copper. H. C. Kenny & G. L. Craig. *Metals Technology,* Jan. 1934, *Technical Publication* No. 525, 8 pages. Prime Lake coppers containing from nil to 40 ounces per ton (0.14%) of Ag were studied. Ag had very little influence on the strength and electric resistance of the Cu, but it increased the temperature required to soften cold-worked Cu. The softening temperature increased as the Ag content increased, but the increase was not directly proportional to the Ag content. This was true for wires held at temperature for only 1 or 2 min. and for wires held at temperature for months. Cold-drawn wires were held for months at 150 and 200°C. and their strength determined periodically. At a temperature of only 150°C. the Ag-free Cu was completely softened within a few days, while those wires containing over 10 ounces per ton of Ag softened but little in 1 year. JLG (11a)

A Study of Six Bearing Bronzes. Oscar E. Harder & Carter S. Cole. *Transactions & Bulletin, American Foundrymen's Association,* Vol. 4, Dec. 1933, pages 314-329; *Metal Industry,* London, Vol. 42, June 23, 1933, pages 639-646; June 30, 1933, pages 666-667. Six bearing bronzes of the compositions 80-10-10-0, 88-10-0-2, 83-7-7-3, 85-5-9-1, 70-10-20-0 and 70-5-25-0% Cu, Sn, Pb and Zn, respectively, representative of modern practice in 4 foundries have been studied. The data include tests for tensile and yield strength, elongation, reduction of area, modulus of elasticity, hardness at room temperature and at elevated temperatures, compressive properties, density as cast and after compression and resistance to pounding at room temperatures and at 350°F. (177°C.). CEJ + Ha (11a)

The Relation of Phosphorus to Copper and Silver (Ueber das Verhalten des Phosphors zu Kupfer und Silber) II and III. K. W. Froehlich. *Mitteilungen des Forschungsinstituts und Probieramts für Edelmetalle,* Vol. 7, Oct. 1933, pages 75-80; Nov./Dec. 1933, pages 91-97. The continuation of previous investigations (*Metals & Alloys,* Vol. 5, Mar. 1934, p. MA 83) show that contrary to general belief presence of P is not necessarily harmful to mechanical properties of Ag-Cu alloys but that improvement can be brought about if complete deoxidation by copper phosphide has been effected. When pouring the metal the contact with air should be as short as possible to avoid absorption of O. For this reason a slight excess of P is desirable and the melt should always be left standing under a cover of charcoal for about 1-2 min. to be sure that complete deoxidation has taken place. Tensile strength, elongation, deep-drawability, corrosion resistance and refinability are all improved if P is not more than 1%, usually 0.2-0.5% gives the maximum effect. Tests with several alloys under different heat treatments are described. Ha (11a)

Aluminium Bronze. F. Hudson. *Metal Industry,* London, Vol. 42, Mar. 17, 1933, pages 297-299; Mar. 24, 1933, pages 327-330; Mar. 31, 1933, pages 349-352; Apr. 7, 1933, pages 378-380. See *Metals & Alloys,* Vol. 4, Dec. 1933, page MA 378. Ha (11a)

The Manufacture of High-class Marine Propellers. Wesley Lambert. *Inspection,* Vol. 4, Oct. 1933, pages 1-22. Incl. discussion. Paper read before the Institution of Engineering Inspection Feb. 8, 1933. Historical review, general design, erosion of propellers are dealt with. Two types of Mn bronzes are most favored as material for high-class propellers, each alloy having a characteristic microstructure. The following chemical compositions and mechanical characteristics are given;

Composition	α-β Microstructure	β Microstructure
Cu	56-58%	48-50%
Sn	approx. 1%	not more than 1%
Fe	not more than 1%	not more than 1%
Al, Mn Ni, Pb	small amounts	small amounts
Zn	40-41%	45-47%
Yield Point	16-18 tons/in.^{2}	18-20 tons/in.^{2}
Breaking load	33-36 tons/in.^{2}	40-43 tons/in.^{2}
Elongation in 2 in.	25-30%	20-25%
Brinell hardness	125-130	145-150

The molding of a propeller follows the usual practice observed in brick-and-loam molding. Particulars in molding and casting (at about 960°C.) are discussed. When the casting has solidified and cooled somewhat, portions of the mold are released in order that the casting may cool out in such a manner as to minimize distortion and internal stresses in the metal, and as a means of controlling the temperature gradient and consequent grain size of the metal throughout the casting. Machining and inspection of propellers are dealt with. Kz (11a)

Contributions to the Thermochemistry of Aluminum (Beiträge zur Thermochemie des Aluminiums) A. Meichsner & W. A. Roth. *Zeitschrift für Elektrochemie,* Vol. 40, Jan. 1934, pages 19-26. Heat of formation of α - aluminum oxide (corundum) was determined by combustion of very pure Al as + 393.3 ± 0.4 kg. cal. at 20°C. and constant pressure. The lower, formerly found values are explained by combustion in clay containers instead of in sintered corundum crucibles; endothermal reactions in the former decreased the heat of combustion. The heat of formation of crystallized aluminum carbide was found to be + 20 ± 3 kg. cal. at 20°C. Procedure is described in detail. 21 references. Ha (11a)

Preparation of Ductile Tantalum by Thermal Dissociation of $TaCl_5$ (Darstellung von duktilem Tantal durch thermische Dissoziation von $TaCl_5$) W. G. Burgers & J. C. M. Basart. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 216, Jan. 26, 1934, pages 223-227. Ta can be deposited on a glowing wire in very ductile form by thermal dissociation of $TaCl_5$ if care is taken that foreign gases are absent for this reason, $TaCl_5$ is best sublimed *in vacuo.* The lattice constant of Ta was determined as $a = 3.296 \pm 0.000_5$A. U. The wire obtained was 1.25 mm. diam. and could be rolled down cold to 50 and 25 microns without becoming hard. A similarly prepared wire of Nb had a lattice constant of $a = 3.294 \pm 0.001$A. U. Ha (11a)

The Physical Properties of Zinc at Various Stages of Cold Rolling. R. Chadwick. *Engineer,* Vol. 155, Mar. 17, 1933, page 267; *Engineering,* Vol. 135, Mar. 24, 1933, pages 326-327; *Sheet Metal Industries,* Vol. 7, May 1933, pages 13-17. See *Metals & Alloys,* Vol. 5, Jan. 1934, page MA 1. LFM+AWM (11a)

Nickel for Light Alloys (Le nickel dans les alliages légers) Jean Cournot. *Revue du Nickel,* Vol. 4, Oct. 1933, pages 137-142. Describes the effect of nickel as an alloying element. Detailed compositions, heat treatments and properties are given of the most important industrial alloys. "Avial" is as light as aluminum and has higher tensile strength than low carbon steel. Composition of "Avial": Cu 1.5-3.5%; Mg 0.25-1%; Ni 0.5-1.5%; Cr 0.5-1%; Si 0.5%. Density of Avial No. 1 (L-2R): 2.77. Melting temperature: 680°C. Tensile strength: 40-44 kg./mm^2. Elastic Limit: 24-28 kg./mm^2. Elongation: 16-22%. Brinell hardness: 125. Modulus of elasticity 7,725 kg./mm^2. AH (11a)

Inner Potential of Metals. James A. Darbyshire. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Ser. 7, Vol. 16, Oct. 1933, pages 761-775. Several footnote references. Diffraction effects from certain metallic cleavage faces are examined by using high voltage electrons (about 30,000 volts). Specimen is freshly cleaved and mounted as quickly as possible on its support by means of a Wood's metal to avoid contamination of the surface by exposure to air. Single crystals of Zn, Sb, Bi, and Te were examined. Purity in all cases was not less than 99.85%. Definite evidence of refraction due to an inner potential has been found from Zn and Sb but not from Bi and Te. Values found are: Sb $E_o = 12$ volts and Zn $E_o = 15.5$ volts. Results are believed to be accurate within at least ± 1 volt. RHP (11a)

The Solidification Point of Iridium (Der Erstarrungspunkt von Iridium) F. Henning & H. T. Wensel. *Annalen der Physik,* Series 5, Vol. 17, July 1933, pages 620-634. See "The Freezing Point of Iridium," *Metals & Alloys,* Vol. 5, Mar. 1934, page MA 77. Ha (11a)

Thermal Treatment Applied to Duplex Aluminum Alloys. (Il trattamento termico applicato alle leghe di alluminio ricoperte) G. Guidi. *Alluminio,* Vol. 2, Nov.-Dec. 1933, pages 323-326. The effect of hardening an aluminum alloy (Al-Cu) pure Al, Alclad 175-T, on the structure, mechanical properties, and resistance to corrosion, is studied. The same degree of heat used in practice was used, i. e., heating to 460°, 475°, 490°, 505°, 520°C. for 2, 3, 5 and 10 minutes, and then quenched in water. One series was then tested for tensile strength, and another for resistance to corrosion by 2 months' immersion in salt water. The optimum improvement in tensile strength is shown by the samples hardened at 505°. Above this temperature, the structure is so changed that the tensile strength drops to a very low figure. Lower temperature and shorter time of heating improves resistance to corrosion. AWC (11a)

On Silicon-Zinc-Copper Alloys (Ueber Silizium-Zink-Kupfer Legierungen) T. R. Edmund. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Jan. 21, 1934, pages 33-35. The alloys considered as marketed under the name Tombasil are those with 10-14% Zn, 4-5% Si, balance Cu. These alloys are distinguished by excellent casting properties, absence of formation of scums in melting and good mechanical properties as shown by data given. Special points to be observed in casting are considered. In the series investigated tensile strength increases with increasing Si content, but constant Zn content, while elongation decreases. Maximum tensile strength is attained with 5% Si. Tombasil alloys have good hot working properties and are fit in particular for parts of thin cross-sections due to their particular casting properties. The alloys proved highly successful for bearings, and for making church bells. GN (11a)

Mercury Crystals; Density, Spec. Resistance, Thermal Expansion, Elastic Constants (Quecksilberkristalle; Dichte, Spez. Widerstand, Thermische Ausdehnung, Elastische Konstanten) E. Grueneisen & O. Sckell. *Annalen der Physik,* Series 5, Vol. 19, Feb. 1934, pages 387-408. Hg forms trigonal crystals and has, at -191°C., a density of 14.47. The electric resistances parallel and perpendicular to the trigonal axis were determined to 0.0557 and 0.0737 10^{-4} resp. at -187.5°C. and the resp. thermal expansion coefficients found to 47 and 37.5 10^{-6} between -188° and -79°C. The relation between thermal and elastic elongation is discussed and a formula expressing it developed. Ha (11a)

A Note on Some Formulae Concerning Viscous and Plastic Flow in Soft Metals. E. W. Fell. *Journal Institute of Metals,* Vol. 54, 1934, 6 pages (Advance copy). A discussion of the observations of flow in soft metals observed by means of the ball test and tensile test. The formulae developed for the 2 types of flow are compared and their significance discussed. 6 references. JLG (11a)

The Electical Conductivity of Aluminium Wire. A. J. Field & J. H. Dickin. *Engineering,* Vol. 135, Mar. 24, 1933, page 327, Apr. 28, 1933, pages 473-475. See *Metals & Alloys,* Vol. 5, Jan. 1934, page MA 1. LFM (11a)

Recent Applications of the B.N.F. Ternary Alloys of Lead. Kenneth Fray. *Journal & Record of Transactions of Junior Institution of Engineers,* Vol. 42, Part 11, Aug. 1933, pages 517-528. Paper read before the Institution in London deals with intercrystalline cracking of Pb due to fatigue and with the elimination of this source of trouble by ternary alloys of the following type developed by the British Non-Ferrous Metals Research Association (1) 99.25% Pb, 0.25% Cd, 0.5% Sb; (2) 98.25% Pb, 0.25% Cd, 1.5% Sn. The mechanical properties of these alloys compare as follows with those of pure Pb

	Ultimate t. s. tons/in^2.	Elongation	Brinell Hardness	Haigh Fatigue Limit tons/in^2.	Bendability
Alloy (1)	1.68	58	6.5	0.74	0.75
Alloy (2)	1.69	62	5.7	0.57	....
Pure lead	1.05	86	3.2	0.18	1.00

Cd considered purely as a hardener for Pb, is twice as powerful as Sb and six times as powerful as Sn. Besides greater hardness and tensile strength, experiments are reviewed which revealed greater resistance to hydraulic bursting stress, fatigue and plumbosolvent water, greater uniformity of grain structure and reaction to mechanical stress in comparison with pure Pb. The ternary alloys are furthermore cheaper. Microphotographs included show the difference in grain structure of ordinary Pb pipe and alloy pipe and the effect of soldering which resulted in grain growth in pure Pb and a consequent weakening of the structure. WHp (11a)

Elasticity Constants of the Aluminum Single Crystal (Elastizitätskonstanten des Aluminiumeinkristalls) E. Goens. *Wissenschaftliche Abhandlungen der Physikalisch-Technischen Reichsanstalts, Berlin,* Vol. 16, No. 1, 1933, pages 167-176. Based on dynamic measurements on Al single crystals of different crystallographic orientation, the specific elongation and torsion are determined and the numerical values for the main elasticity parameters of the Al single crystal derived. The elastic anisotropy of Al is relatively small if compared with other cubic metal crystals. EF (11a)

Isotope Report. The Chemical Elements and Atomic Types According to the Status of Isotope Investigations (Report of Studies from the End of 1932 to the End of 1933) (Isotopen-Bericht. Die chemischen Elemente und Atomarten nach dem Stande der Isotopen-Forschung [Bericht über die Arbeiten von Ende 1932 bis Ende 1933]) Otto Hahn. *Berichte der Deutschen Chemichen Gessellschaft,* Vol. 67, Jan. 10, 1934, pages 1-8. A review of investigations carried on during the past year on isotopes of the elements H, Li, Be, B, C, O, Fl, Ne, Cl, Ga, Rb, Cd, and Hg. A supplementary table of isotopes and atomic weights to the 1932 table is given. 55 references. CEM (11a)

Some Temper-Hardening Copper Alloys Containing Nickel and Aluminium. H. W. Brownsdon, Maurice Cook & J. H. Miller. *Engineering,* Vol. 136, Dec. 22, 1933, pages 695-698; *Institute of Metals, Advance Copy,* No. 640, Sept. 1933, 32 pages; *Metal Industry, London,* Vol. 43, Sept. 22, 1933, pages 281-283. A precipitation-hardening treatment consisting of quenching from 900°C. and reheating to 500°-600°C. hardens Cu-base alloys containing Ni and Al. For appreciable hardening, the alloys should contain at least 4 times as much Ni as Al. The Al content should exceed 0.5%. An alloy of 92.5 Cu, 6 Ni, and 1.5 Al quenched from 900°C. and reheated to 600°C. for 2 hr. had a tensile strength of 44.3 tons/in^2., a proportional limit of 17.9 tons/in^2., an elongation of 20%, and a diamond-pyramid hardness of 194. Cu-Zn, Cu-Sn, and Cu-Mn alloys containing Ni and Al all hardened when quenched and reheated. Mn, however, appeared to influence the hardening adversely. Some alloys quenched, cold-rolled, and then reheated developed excellent properties. 9 references. Ha + JLG + LFM (11a)

Design-Technique of Light-Metal Castings (Konstruktionstechnik von Leichtmetall-Gussstücken) W. Hartl. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, Dec. 23, 1933, pages 1355-1358. Considerations to be taken into account when designing structural parts of light-metals are reviewed and examples given for proper shape of composite parts, especially under high stresses. Ha (11a)

Frequency of Strontium (Ueber die Häufigkeit des Strontiums) G. von Hevesy & K. Wuerstlin. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 216, Jan. 26, 1934, pages 312-314. Tables are given for Sr content of eruptive, effusive and sediment rocks and showing also where deposits occur; there is 1 part Sr in 9000 parts by weight in eruptive and 1 in 50,000 parts in sediment rocks; stone meteorites showed about 1 in 40,000 parts. Ha (11a)

On the Sorption of Hydrogen by Reduced Nickel. II. Adsorption of Hydrogen by Reduced Nickel at Low Temperatures. Shun-ichiro Iijima. *Scientific Papers Institute of Physical & Chemical Research, Tokio,* Vol. 22/23, Dec. 1933, pages 34-43. (In English.) Adsorption of H by reduced Ni at 100°, 19°, —45.2°, —78.5°, —112° and —183.5°C. and at low pressures have been determined. No experimental evidence of Nikitin's statement (Zeitschrift für anorganische Chemie, Vol. 154, 1926, page 130) was found that the quantity of H adsorbed at room temperature has any bearing on the pressure. It was also found incorrect that Ni and H form a compound at this temperature. Maximum and minimum points on the isothermal curves even at low pressures of 0.1 mm. and 1.5 mm. have been found experimentally. This is in analogy to the adsorption curves of H in Mn oxide and CO in Pd established by H. S. Taylor and his collaborators (*Journal American Chemical Society,* Vol. 53, 1931, page 2168). Smooth isothermal curves will be obtained if H is introduced slowly at low temperatures. Otherwise the amount of molecularly adsorbed gas is increased by a H quantity accounting for the so-called activated adsorption due to temperature rises (adsorption heat) on the Ni surface. WH (11a)

What Must the Designer Know of Light-Metal? (Was muss der Konstrukteur vom Leichtmetal wissen?) *Aluminium,* Vol. 15, Dec. 31, 1933, pages 1-5. The light metal alloys now available are enumerated, the forms in which they may be had are described, and their physical and mechanical properties are given. Ha (11a)

Practical Method for Determining Heat Conductivity of Small Metal Bars (Méthode Pratique sur la Détermination de la Conductibilité Thermique des Petits Barreaux Métalliques) P. Vernotte. *Science et Industrie,* Vol. 17, Jan. 1933, pages 17-20. Author explains his method of heat conductivity measurements. This method involves no special machining of the small bar used and no measurement of bar temperature. Article deals with theoretical side of method, experimental work to be related later. FR (11a)

The Hall Effect and Some Other Physical Constants of Alloys. Part I. The Lead-Bismuth Series of Alloys. W. Rheinallt Thomas & E. J. Evans. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Ser. 7, Vol. 16, Supp, No., Aug. 1933, pages 329-353. The chief object of this research was to study in greater detail the reversal of the Hall coefficient with variation of the magnetic field in the case of the Bi rich alloys. Results are shown in numerous graphs and charts. RHP (11a)

Some Causes of Variation in Hardness of Gold-Copper Castings. Harry H. Asher & John A. Comstock. *British Journal of Dental Science & Prosthetics—Prosthetics Section,* Vol. 79, Jan. 1934, pages 12-16. Reprinted from *Journal of Dental Research,* Vol. 13, 1933. JCC (11a)

Use of Beryllium in the Metallurgy of Copper (L'Emploi du Glucinium [ou Beryllium] dans la Metallurgie du Cuivre) *Cuivre et Laiton,* Vol. 6, Feb. 28, 1933, pages 89-92. A review of the use of Be as alloying material with Cu. In very small percentages, 0.01-0.02, it acts as a very good deoxidizer and can very well replace Si and especially P if it is required to obtain a material with good electrical conductivity. The influence of larger amounts of Be is given in a table. The hardening effect of Be is particularly pronounced after a heat treatment which heats the metal first to 800° C. for 1 hr. followed by quenching in water or oil, then heating again to 350° C. for 30 to 45 min., followed by slow cooling; between the 2 operations the alloy may be cold worked or rolled. The best content seems to be 2-3% Be. A few historical remarks on Be and its physical properties are added. 17 references. Ha (11a)

Copper Alloys Combining High Mechanical Resistance and Good Electric Conductivity (Alliages de Cuivre réunissant une Résistance mechanique élevée et une bonne Conductibilité électrique) *Cuivre et Laiton,* Vol. 6, Aug. 30, 1933, pages 401-403. Lists types of Cu and Cu alloys which are at present used in the electrical industry. The high price of Be prevents the more frequent use of Be bronzes. Ha (11a)

Recent Advances in Non-Ferrous Metallurgy—Chemical Engineering Aspects. *Industrial Chemist,* Vol. 9, Nov. 1933, pages 411-413. 37 references. A résumé of previously reported work in the metallurgy of Cu, Ni, Pb, Zn, Mg and their alloys for the period 1932-1933. RAW (11a)

A New Corrosion Resistant Material (Ein neuer korrosionsbeständiger Werkstoff) *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 24, Feb. 4, 1934, pages 63-64. In making Corrix metal (86% Cu, 10% Al, 4% Fe) high purity of raw materials is highly important. In shaping all working methods (casting, forging, drawing, heat treating, etc.) are applicable. Structure is uniform and finely grained. Corrosion stability need not be imparted by heat treating, Corrix metal possesses this property in cast state. GN (11a)

The Electrokinetic (Zeta) Potentials of Thin Metal Films. Grant W. Smith & L. H. Reyerson. *Journal of Physical Chemistry,* Vol. 38, Feb. 1934, pages 133-150. A streaming potential method for the determination of the electro-kinetic potentials of metals in contact with their ions has been developed, and measurements were made on the systems silver-silver ion and nickel-nickel ion, as well as on pure silica gel. Metallized silica gels were used in the investigation. They were prepared by the new process of absorbing complex ions of ammonia on the silica gel and later reducing to the metallic state. A vacuum tube potentiometer and a vacuum tube conductivity bridge have been adapted to this type of work with excellent results. Fundamental differences between the electrokinetic potentials and the Nernst potentials were found for the systems studied. EF (11a)

Beryllium and Its Alloys. H. A. Sloman. *Metal Industry,* London, Vol. 44, Feb. 9, 1934, pages 160-162; Feb. 16, 1934, pages 183-186; Feb. 23, 1934, pages 210-211. An exhaustive survey of the present status of production, uses and properties of Be and Be alloys. Be has considerable value as deoxidizer particularly in casting Cu. Be-plating can not be done from aqueous solutions, but it can be deposited on to Cu, Ni, Fe, Al and others by using a fused bath containing beryllium-oxyfluoride together with sodium fluoride at 600° C. or more. The application of Be is still in its first stages. Ha (11a)

Tungsten and Its Uses. L. Sanderson. *Sands, Clays & Minerals,* Vol. 2, Feb. 1934, pages 13-16. Brief description of discovery and properties of W is given and the minerals for its supply described. Present uses are for electric appliances, lighting contrivances, non-ferrous alloys, in steel. Ferro-tungsten is the principal alloy. Ductile W wire of 0.0006" diam. is used in electric lamp bulbs. Ha (11a)

Alloys of Silver and Beryllium. H. A. Sloman. *Journal Institute of Metals,* Vol. 54, 1934, 20 pages (advance copy). Experiments with Ag-Cu-Be alloys showed that there was a miscibility gap in the liquid. No liquid miscibility gap is found in the systems Ag-Cu, Cu-Be, and Ag-Be. The Ag-Be system was determined by thermal and microscopic methods. A eutectic is formed at 10.4 at. % Be and 881° C. At the eutectic temperature the solubility of Be in Ag is 3.5 at. %. The solubility decreases with decreasing temperature. An undetermined amount of Ag is soluble in Be at the eutectic temperature. In the Be-rich alloys a transformation at 750° C. was observed. The data indicate that Be passes through an allotropic transformation somewhat below 750° C. A simple diagram shows 750° C. as a peritectic temperature at which the low-temperature Be-rich phase is formed. Alloys containing at least 92.5% Cu and 0.4% Be are the color of "standard silver" and are tarnish resistant. 9 references. JLG (11a)

Industrial and Constructive Treatment of Light Metals (Materialtechnische und konstruktive Behandlung von Leichtmetall) W. Zarges. *Aluminium,* Vol. 15, Mar. 31, 1933, pages 1-4; Apr. 15, 1933, pages 1-3. An exhaustive discussion of kinds of light metals available, their physical and mechanical behavior, points to be observed in the design if full advantage of their properties is to be obtained. Mere imitation of constructive and working methods of steel is impossible, the individual characteristics of the material to be used must be taken into account. Ha (11a)

Beryllium Heavy Metal Alloys (Über Beryllium-Schwermetallegierungen) W. Hessenbruch. *Zeitschrift für Metallkunde,* Vol. 25, Oct. 1933, pages 245-250. Cu-Be alloys can best be melted under a fused chloride flux but Be alloys with Ni, Co, Cr are best melted (and cast) in vacuum; this provides an alloy with excellent forging qualities. Binary Be alloys are too expensive for wide use and attempts have been made to prepare ternary alloys requiring less Be but with pronounced age-hardening properties. This is possible because most metals (not Ni) lower the solid solubility of Be in Cu and age-hardening thus obtains at lower Be contents. Cu with 1% Be shows very little hardening after quenching from 850° and aging at 350°, whereas the additions 3% Ti, 5% Ag, 5% Si, 5% Mn, 10% Fe, respectively, cause marked hardening, roughly up to 260 Brinell hardness number (BHN). These elements without Be give little hardening and the effect is to be ascribed chiefly to Be. Cold working after quenching but before aging increases the rate of aging and the maximum hardness. The Cu-Ag-Be alloy shows good electrical conductivity, 22.10 reciprocal ohms. Ni with 1% Be and 4, 6, and 8% Mo, respectively, gives similar results, both on normal aging and aging after cold work (aging at 500°), with BHN up to 450. Ni with Be and Cr shows similar behavior, though Cr appears to form a compound with Be; results are given for an alloy with 80% Ni, 20% Cr, with 1.2% added Be, quenched from 1000° and aged at 400-500°; BHN approaches 460. The acid and heat resisting alloy "Contracid" (60% Ni, 15% Cr, 7% Mo, residue Fe with small amounts of Mn and Si) may be made susceptible to age-hardening with 0.6% Be. In the quenched state this alloy may be worked (BHN 200); aging at 500-550° develops a hardness number of 300; cold working followed by aging gives a hardness number of 500. This hardness is permanent over a wide temperature range; at 600° no loss of hardness obtains during 60 hours. This high temperature stability is greater than that in pure Ni-Be alloys. The resistance to creep (Rohn test) is high. Fe is added to Co to suppress the α-β transformation; 2% Be gives an age-hardening alloy; further additions of Cr, W, Mo, and Fe lead to higher hardness values. A Co-Be-Cr-Fe alloy which has a BHN of 200 in the quenched state will develop a hardness of 650-700 on aging followed by cold-rolling; this alloy must be cold rolled after aging whereas the previously described alloys are cold rolled before aging. The effect of cold rolling before aging on alloys of Cu + 2.5% Be, Ni + 1.7% Be, Contracid + Be, is shown in a series of graphs (as are the other data in this paper). A table shows values for yield point, breaking strength, elongation, Young's modulus, BHN, notch impact for these three alloys after (1) quenching, (2) quenching and aging, (3) cold rolling, and (4) cold rolling and aging. These alloys are finding application in the manufacture of thin-walled small seamless tubing, used among other things for hypodermic needles. Contracid is used for surgical needles, for valves and valve springs for watches because of their low value of temperature coefficient of elasticity. Followed by discussion in which additional data on similar alloys are given. RFM (11a)

Aluminum Bronzes. Castings of the Bronze of Sainte-Claire-Deville (Les Bronzes d'Aluminium. Les Moulages du Bronze de Sainte-Claire-Deville) Leon Guillet. *Cuivre et Laiton,* Vol. 6, Aug. 30, 1932, pages 395-396. This bronze (90 Cu and 10 Al) has, in cast state, a tensile strength of 45-50 kg./mm.^{2} It is brittle due to a coarse grain when cast in sand and should be cast in a chill-mold or artificially cooled mold. Ha (11a)

Studies of the Similarity of Ruthenium to Iron: Nitric Oxide Compounds of the Bivalent Ruthenium (Studien über die Eisenähnlichkeit des Rutheniums: Stickoxydverbindungen des zweiwertigen Rutheniums) W. Manchot & Hans Schmid. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 216, Dec. 12, 1933, pages 99-103. Ru is similar to Fe in that it also can bind NO in several valencies, in particular the bivalent state. RuI_2NO and $RuBr_2NO$ have so far been produced. 9 references. Ha (11a)

Internal Stresses in Quenched Aluminum and Some Aluminum Alloys. L. W. Kempf, H. L. Hopkins & E. V. Ivanso. *Metals Technology, American Institute Mining & Metallurgical Engineers, Technical Publication* No. 535, Feb. 1934, 23 pages. Cylindrical specimens of Al and different Al alloys were heat treated and internal stresses estimated from change in dimensions when layers were removed from the surface or holes drilled axially. Much of the work was done on specimens 7 in. high and 7 in. in diameter. The magnitude of the stresses depended on the quenching temperature and on the quenching medium. When quenched from a very high temperature in iced water the maximum stress approached the yield stress. When quenched in oil the stresses were smaller. When quenched from normal quenching temperatures in boiling water the indicated stresses were of the same order of magnitude as the errors of measurement. Stresses in the cylindrical specimens were compressive at the surface and tensile at the center. The longitudinal stresses were of a higher order of magnitude than the tangential or radial stresses, which were about equal at the center of the specimen. To bring about practically complete stress removal by annealing it was necessary to heat to above 500° F. 10 references. JLG (11a)

Uhlmann Capillary Metal. Sintered Bronze (Das Uhlmann-Kapillarmetal [Sinterbronze]) Joh. Mehrtens. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Feb. 4, 1934, pages 53-54. The metals considered, possessing a porous structure, are prepared by pressing metal chips or metal powders and subsequently sintering by means of high frequency current. With proper composition, mechanical and physical properties of such sintered metals are excellently adapted for bearings, bushings, etc. Uhlmann developed special types of bearings in which such sintered materials are used. These "Capillary" bearings are distinguished by low wear, low oil consumption and simple attendance. Errors made in machining sintered metal bearings are especially dealt with. Results of practical experience are considered. GN (11a)

Silicon Brasses: A New Series of Technical Alloys. E. T. Richards. *Metal Industry,* London, Vol. 44, Mar. 9, 1934, pages 269-270. A series of Cu-Zn alloys with Si additions has proved to be quite useful for replacing more expensive Cu-Sn alloys; the following are at present made:

No.	Cu %	Si %	Zn %	Solidification starts at °F.
1	84	4	12	1690
2	86	4	10	1750
3	87	3	10	1800
4	88	4	8	1780
5	90	2	8	1890

These alloys are very fluid at elevated temperatures and can be poured at temperatures below the vaporizing temperatures of Zn so that the losses of the latter by volatilization and the corresponding contamination of the castings are practically avoided; they also fill out the castings much better than common Sn bronzes or brasses which makes sound thin-walled castings possible. Castings can be made in green and dried sand as well as in iron molds; green sand molds being preferable. These bronzes possess satisfactory hard-working properties, they have been tried as bearing metal and for large bells. Ha (11a)

The Diffusion of Zinc and Iron at Temperatures Below the Melting Point of Zinc. Gilbert Rigg. *Journal Institute of Metals,* Vol. 54, 1934, 13 pages (Advance copy). Clean sheets of Zn and a low-C steel were clamped together and heated to temperatures below the melting point of Zn. Diffusion commenced at temperatures below 300° C. and was fairly rapid at 380° C. It proceeds by the formation of diffusion cones that spread out from points where the contact between the Zn and Fe is the best. The diffusion is independent of the purity of the Zn. Two well-defined layers of diffusion products are formed, a thin layer of constant thickness containing about 17% Fe next to the Fe and a thicker layer of 0 to 11% Fe outside this. The mechanism of the diffusion process is discussed. JLG (11a)

Ionization Heats of Some Metals (Ueber die Ionisationswärmen einiger Metalle) W. A. Roth & A. Buechner. *Zeitschrift für Elektrochemie,* Vol. 40, Feb. 1934, pages 87-89. Heats of anhydrous chlorides of Al, Ga, In, Zn and Cu were measured and from them the ionization heat calculated. Ha (11a)

Copper-Tin Alloys. I. The Bronzes. *Tin,* Feb. 1933, pages 15-18. Metallurgy of Cu-Sn alloys is discussed generally and different constituents described. Ha (11a)

Phosphor Bronze. *Automobile Engineer,* Vol. 23, Oct. 1933, page 387. Bronzes may be divided into 3 classes according to P content: P 0.05% to 0.1%, P 0.35% to 0.5%, and P 0.5% to 1.25%. The last type is relatively hard and resists wear. It is suitable for bearings, bushings, gear wheels, valve slides and similar parts. Gives a few brief details of casting process and uses. RHP (11a)

The Surface Tension of Mercury in a Vacuum and in the Presence of Hydrogen. R. Stevenson Bradley. *Journal of Physical Chemistry,* Vol. 38, Feb. 1934, pages 231-241. Recent determinations of the surface tension of Hg show considerable discrepancy. A new modification of the flat drop method using the top surface of the drop which was free from error, was employed to redetermine the surface tension of Hg. The mean value of 500.3 dynes/cm. at 16.5°C. was obtained. The fall of the surface tension in H_2 at pressures from 0-100 mm. was studied and interpreted theoretically. The surface was illuminated with light from a mercury vapor lamp. No immediate effect was noticed, but the surface tension fell more rapidly. 16 references. EF (11a)

The Corner Metals of Electrical Distribution: Copper, Aluminum and Lead. F. J. Brislee. *Journal Society Chemical Industry,* Vol. 52, May 26, 1933, pages 447-451. General discussion of the production, corrosion properties and electrical properties of Cu, Al and Pb. VVK (11a)

Cupro-Nickels with Beryllium (Cupro-Nickels au Glucinium) Marcel Ballay. *Usine,* Vol. 43, Mar. 8, 1934, page 31. An alloy composed of 67.52% Ni, 29.94% Cu, 1.14% Be, 0.62% Fe, 0.25% Mn and 0.07% Mg was investigated. It could be hardened when heated to between 300° and 600°C. If heated for 100 hrs. to 100° the hardness of the alloy when quenched from 1075° was not affected whether cold-rolled or not; heating to 200° increased the hardness of the not cold-rolled alloy but not of the cold-rolled samples. Between 200° and 300° the hardness increases rapidly for the not cold-rolled material, while between 300° and 500° the curves hardness-temperature are practically parallel and the cold-rolled samples remain harder up to 650°C. The hardening effect in this alloy is explained by a regrouping of the atoms due to cold-rolling which also retards precipitation of components at low temperatures. Precipitation hardening has little influence on the corrosion of the alloy, no strong intergranular corrosion could be found for the hardest specimens although the microscope reveals a distinct precipitation in the grain boundaries. Ha (11a)

Mechanical Properties of Electrolytic Zinc Sheets (Mechanische Eigenschaften von Elektrolytzinkblechen) O. Bauer & J. Weerts. *Metallwirtschaft,* Vol. 12, Oct. 27, 1933, pages 615-618. From .01 to .06% of Pb, Fe, Cu, and Cd have appreciable effects on the mechanical properties of hot rolled sheets of electrolytic Zn. Sheets, which are rolled in one heat to 2 mm. thickness with a finishing temperature of 60 to 90 C., but with various initial temperatures, have practically similar average mechanical properties at room temperature. Zn alloyed with .9% Pb has about 25% higher tensile strength at room temperature than average Pb-free Zn, but its elongation and bending properties are lower. The properties of the alloyed Zn are still within the wide limits in which pure Zn varies. The addition of .9% Pb does not affect the tensile strength at elevated temperatures, but the critical temperature range for hot working is widened. 12 references. CEM (11a)

On the Phase Boundary Potentials of Monolayers of Fatty Acids on Metals. L. Jacobs. *Transactions Faraday Society,* Vol. 30, Feb. 1934, pages 303-310. Contains bibliography. It was shown that the absorption of fatty acids by metal surfaces could be followed by measuring the phase boundary potential. Uniform spreading from a solvent can be obtained on a dry metallic surface. Myristic and Caprylic acids on Ag, Au and Pt were studied. The phase boundary potentials attain maximum values indicative of saturation. Using 20.6 A.U.^{2} per molecule for closest packing the specific surface was evaluated. The values of 5.0 for Pt, 2.7-6.7 for Au, and 4.7 to 7.8 for Ag were obtained. Caprylic acid gave continuous results, but myristic acid gave indications of a phase change in the nature of the monolayers of fatty acid on metal. PRK (11a)

The Freezing Point of Iridium. (Der Erstarrungspunkt von Iridium) F. Henning & W. T. Wensel. *Wissenschaftliche Abhandlungen der Physikalisch-Technischen Reichsanstalt, Berlin,* Vol. 16, No. 1, 1933, pages 192-206. See *Metals & Alloys,* Vol. 5, Mar. 1934, page MA 77. EF (11a)

On the Sorption of Hydrogen by Reduced Nickel. III Heat Treatment of Reduced Nickel and Its Relation to the Sorption Velocity and to the Quantity of Hydrogen Sorbed. Shun-ichiro Iijima. *Scientific Papers Institute of Physical & Chemical Research, Tokyo,* Vol. 23, Jan. 1934, pages 164-172. (In English) Experiments have been made to determine whether the heat treatment of reduced Ni which exerts a remarkable effect on the catalytic action of the metal, may also affect the sorption velocity and quantity of H to be sorbed. The same material has been used as in the previous reports (See abstracts in *Metals & Alloys*). The relation between the heat treatment of reduced Ni at 300°, 400°, 450° and 500° C. and the quantity of H sorbed at 0° C. and 20.30 ± 0.01 cm. pressure has been investigated. The heat treatment has been confirmed to shorten the time in which the adsorption reaches equilibrium and to diminish the quantity of adsorbed hydrogen. The velocity with which H diffuses in reduced Ni has been proved not to be affected by the heat treatment up to 500° C. WH (11a)

Casting Beryllium-Copper Alloys. Edwin F. Cone. *Foundry,* Vol. 61, Sept. 1933, pages 20-21, 59-69. **A New Product-Beryllium-Copper Castings.** *Iron Age,* Vol. 131, June 29, 1933, page 1027, Adv. Sec. page 14. See *Metals & Alloys,* Vol. 5, May 1934, page MA 219. VSP (11a)

Electric Conductivity of Single Crystals (Ueber die elektrische Leitfähigkeit von Einkristallen) W. Lehfeldt. *Zeitschrift für Physik,* Vol. 85, Oct. 14, 1933, pages 717-726. The ionic conduction of single crystals which are to be used for photoelectric measurements is investigated. The conductivity is an actual constant of the material only in a narrow range below the melting point; at lower and especially at lowest temperatures this conductivity is superimposed by an additional "disturbing conductivity" which soon preponderates. Results of measurements on a few substances are given. 14 references. Ha (11a)

Does Copper Pipe Emit Heat? M. B. Lowe. *Domestic Engineering,* Vol. 142, Apr. 1933, pages 40-42, 100. Dealing with the application of Cu tubing for steam and hot water mains and risers, heat transfer values for galvanized brass, Al, Fe, and Cu pipes are compared and the influence of the finish of the metal surface in regard to the amount of heat given off is pointed out. Kz (11a)

Mechanical and Metallographic Properties of Various Light Casting Alloys (Caratteristiche meccaniche e metallografiche di alcune leghe leggere da fonderia) C. Panseri. *Alluminio,* Vol. 2, Mar.-Apr. 1933, pages 59-86. The influence of pouring temperature on the mechanical and metallographic properties of Duralite is determined. Tests were made at 668°, 868°, and 996° C. The tensile strength drops as the pouring temperature is increased. The crystal structure of the samples cast at 668° C. is fine, but at the higher temperatures it becomes coarser. Changing the temperature at which tempering is carried out also affects the properties of Duralite. Samples tempered at 530° C. have higher tensile strength than those tempered at 510° C. Increasing the Si content (Duralite AS) causes the crystals to grow larger; reducing Fe from 1.5% to 0.4% does not affect the macro-structure (duralite BF); omitting Ti produces a much coarser crystalline structure (duralite BT). The copper alloy L.8.T, poured in sand, or chill-cast, shows the basic solid solution of Al-Cu, crystalline $CuAl_2$, and a constituent X (iron-bearing) with a needle-like structure. AWC (11a)

New Non-ferrous Alloys. *Electrical Review,* Vol. 114, Feb. 23, 1934, page 287. Imperial Chemical Industries, Ltd., has developed a series of Cu alloys to which the generic name "Kunial" has been given. Remarkable feature of these alloys is that heating them to 400°-600°C. improves greatly their mechanical properties. For example, by heating the soft quenched alloy brass strip to 500°C., the diamond pyramid hardness number is increased about 100, the proportional limit and proof stress are multiplied fourfold, the tensile strength is increased 31,000 lbs./in.^{2}, and the elongation is halved. If the cold-worked alloy is heated to 450°C., the diamond pyramid hardness number is increased about 40, and the proportional limit tensile strength, and elongation are increased. MS (11a)

Aluminium, the Metal of the Present and the Future. *Machinery,* N. Y., Vol. 40, Oct. 1933, pages 81-84. Advantages of light weight in various fields of applications are illustrated by examples. Ha (11a)

Copper Alloys That Have the Strength of Steel. *Machinery,* N. Y., Vol. 40, Oct. 1933, pages 104-105. Various types of bronzes and fields of application are reviewed. Ha (11a)

Beryllium Copper. *Metal Industry,* N. Y., Vol. 32, Feb. 1934, pages 48-49. A summary of the methods of handling Be-Cu is given, including the details of casting. The castings are held at 1475-1500° F. under pyrometric control for two hours and quenched in water; Brinell hardness number obtained is 100. If reheated to 525-575° F. the hardness is raised to 375-400. The hardening of wrought metal is discussed also. Lists of properties and uses are given. Contains bibliography. PRK (11a)

Powdered and Granulated Aluminium. *Metal Industry,* London, Vol. 44, Mar. 30, 1934, pages 350-353. Fields of application of coating and painting with Al, its advantages, composition of paints and wearing qualities are described. Al powder has supplanted Zn powder in the extraction of Au and Ag by cyanide of potassium solution from ores. Ha (11a)

Application of Gallium (Emplois du Gallium) *Usine,* Vol. 43, Mar. 8, 1934, page 31. Ga-metal resembles Ag, is bluish-white, density 5.95, resists oxidation and has a high reflective power. Its price is given as 12 Fr. per g. and it can be supplied in commercial quantities. Melting point is 30.5°C., boiling temperature 1982°. It is used for replacing Hg in instruments and particularly in electric lamps, and also in dentistry and optical devices. Ha (11a)

"Tin-Free" Leaded Bearing Bronze. H. K. Herschman & J. L. Basil. *Metal Industry,* London, Vol. 43, Sept. 8, 1933, pages 219-222. See *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 156. Ha (11a)

The Effect of Sulphur and Iron on the Physical Properties of Cast Red Brass (85 Cu, 5 Sn, 5 Zn, 5 Pb) H. B. Gardner & C. M. Saeger, Jr. *Proceedings American Society for Testing Materials,* Vol. 33, Pt. 2, 1933, pages 448-458. Progress report on investigation sponsored by the Non-Ferrous Ingot Metal Institute at the Bureau of Standards. Three distinct types of test bars were cast at different pouring temperatures. In the study of the effect of sulphur, heats were cast at five pouring temperatures from 1900 to 2300° F. with additions ranging from 0.025 to 0.10% sulphur. In the study of the effect of iron, heats were cast at the pouring temperatures of 1950, 2100 and 2250° F. with the additions ranging from 0.1 to 0.60% iron. The pouring temperature was found to have a marked influence on the tensile strength, Brinell hardness, electrical resistivity and density of the sand-cast bars, which was decidedly greater than the influence of the added impurity. The best results, for the physical properties studied, were obtained on the test bars poured at 2100° F. Addition of iron showed an improvement in all physical properties of this brass composition with the exception of the electrical resistivity. The running qualities of the alloy were improved and the shrinkage was unchanged by the small addition of sulphur and iron. The solidus and liquidus temperatures of the alloy were not affected by the additions of sulphur and iron. VVK (11a)

Special Alloys (Speziallegierungen) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Mar. 18, 1934, page 122. Discusses composition, properties, and application of (1) Elkonit (Cu-W alloy) (2) different types of Elektron alloys (3) Engestrium, a special type of Brittania alloy. GN (11a)

A Contribution to the Question of Radioactivity of Zinc (Ein Beitrag zur Frage der Radioaktivität des Zinks) H. Fesefeldt. *Zeitschrift für Physik,* Vol. 86, No. 9/10, 1933, pages 611-614. Repeated tests with Zn residues gave only a very much smaller effect of formerly observed α-radiation, if its existence is not entirely questionable. 7 references. Ha (11a)

The Metal Cobalt and Some of Its Uses. B. E. Field. *Mining & Metallurgy,* Vol. 14, July 1933, pages 303-305. A paper presented before the New York section of the American Institute of Mining Engineers. Condensed discussion of Co from the time of its discovery to present day utilization in various alloys. Includes information on Co deposits and importation into the United States. VSP (11a)

The Malleability of Nickel and of Monel Metal. Owen W. Ellis. *Journal Institute of Metals,* Vol. 54, 1934, 16 pages (Advance Copy No. 662). Malleability was determined from reduction in height of cylinders flattened by a falling weight. Commercial Ni and Monel metal, both cold worked, were used. Malleability values for temperatures up to near the melting point were determined. For Ni there was an inflection in the malleability-temperature curve at about 840°C. This is approximately the temperature at which rapid softening takes place on annealing cold-worked Ni. In the ranges 20-500°C. and 840-1100°C. the malleability curve was a straight line. The malleability-temperature curve for Monel metal was of the same type as that for Ni. The influence of annealing at different temperatures on the malleability curve for Ni was studied. 5 references. JLG (11a)

Light Metals in Germany. Hans Diergarten. *Metal Progress,* Vol. 23, Sept. 1933, pages 56, 62. Since the expiration of the "duralumin" patents a new alloy under the name "bondur" of similar composition, Cu 2-5%, Mg 0.5-2.0%, with Mn, Si, and Fe in small amounts in an Al alloy is being produced in Germany. Solution is effected by a heat treatment at 490° to 510°C. (about 930°F.) in a fused salt bath and water quenching. After quenching and aging the material has a tensile strength of 57,000 to 64,000 lbs./in.^{2}, elastic limit of 40,000 to 42,500 lbs./in.^{2} and elongation of 23 to 16%. Tensile strength and elongation have been observed to actually increase at —150°F. over these properties at room temperatures. WLC (11a)

Beryllium and Its Alloys (Le Glucinium et ses alliages) Jean Challonsonnet. *Aciers Spéciaux Métaux & Alliages,* Vol. 8, Nov. 1933, pages 363-370. This is the second and last part (see *Aciers Spéciaux Métaux & Alliages,* Vol. 8, June 1933, pages 168-171) of a critical review of the book "Beryllium. The Production and Application," translated by R. Rimbach and A. S. Michel, The Chemical Catalog Company, Inc. See *Metals & Alloys,* Vol. 3, Oct. 1932, page MA 288. GTM (11a)

Ordinary and Special Bronzes. Some other Special Bronzes (Les Bronzes Ordinaires et les Bronzes Spéciaux. Quelques autre Bronzes spéciaux) Leon Guillet. *Cuivre et Laiton,* Vol. 6, Feb. 28, 1933, pages 81-82. The effect of metals other than Zn, Pb and P on Cu-Sn alloys is discussed. The addition of Al is not beneficial; Cu-Sn-Al alloys are inferior to the binary Cu-Sn alloys and particularly the binary Cu-Al alloys. The addition of Mn does not improve the alloys but it is not as injurious as Al. Ni additions act similar to Zn, increasing the content of α-solution in the alloy and causing the δ-phase to disappear, so that the resistance to friction is diminished and the hardness reduced. No results were obtained by the addition of Fe to bronzes. Additions of Si and Be have quite particular effects and will be treated in a separate article. Ha (11a)

Special White Metal Alloys (Spezial Weissmetallegierungen) E. Richards. *Die Metallbörse,* Vol. 24, Jan. 6, 1934, pages 17-18; Jan. 13, 1934, pages 49-50; Jan. 20, 1934, pages 81-83; Jan. 27, 1934, pages 113-114; Feb. 3, 1934, page 146. In continuation of a previous review of special Al alloys (See *Metals & Alloys,* Vol. 4, May 1933, page MA 133 1-R) special brasses, special bronzes and special Ni alloys, all commercially known or patented alloys on Sn-Pb-Zn base are reviewed. The list includes the white metal bearing alloys, Sn solders, type metals, ornamental alloys, low melting alloys, pewters, die casting alloys, etc. This unique review lists the trade names of some 190 alloys, compiles 337 chemical analyses, briefly characterizes the main utilization and in some cases judges the usefulness of the alloy. EF (11a)

Study of Paramagnetism in Alloys (Sur l'Interpretation des Properties Paramagnétiques des Alliages) L. Neel. *Comptes Rendus,* Vol. 198, Apr. 4, 1934, pages 1311-1313. Surveys derivation of formula for magnetic properties of solid solutions of ferromagnetic alloys. Straight line of Curie-Weiss law as applied to pure metals becomes a curve for alloys. Discusses particularly alloys of face centered cubic system. The Curie constant for the paramagnetic alloys of Mn and Cr is given as a function of the susceptibility. FHC (11a)

Nida-Bronze (Nida-Bronze) *Automobiltechnische Zeitschrift,* Vol. 37, Feb. 25, 1934, pages 115-117. This bronze contains 8-9% Sn and an undesignated amount of P and is said to be particularly suitable as bearing metal. The bearing journal is made of tubes which have been manufactured from cast billets by repeated drawing and annealing. The bearing temperature keeps very low even under very high pressures, the temperature rise was, for instance, for 250 kg./cm.^{2} 28° C. at 1 m./sec. peripheral speed, 37° for 2 m./sec. and 50° for 3.2 m./sec. Characteristic properties of the alloy are:

State	Tensile strength	Elongation	Elast. limit	Yield point	Brinell
Soft	about 40 kg./mm.^{2}	70%	14 kg./mm.^{2}	15 kg./mm.^{2}	95
Hard	about 80 kg./mm.^{2}	7%	76 kg./mm.^{2}	52 kg./mm.^{2}	200

Density is 8.75 kg./dm.^{3}, melting point 1000-1030° C.; spec. electric resistance at 20° C. 0.128 ohm./mm.^{2}. Heat expansion coefficient 17x10^{-3} per 1° C. Heat conductivity 0.142 cal./cm. sec. °C. and modulus of elasticity 11300 kg./mm.^{2} Ha (11a)

Ordinary and Special Bronzes. IV. Ordinary Aluminum Bronzes (Les Bronzes ordinaires et les Bronzes spéciaux. IV. Les Bronzes d'Aluminium ordinaires) Leon Guillet. *Cuivre et Laiton,* Vol. 6, Nov. 30, 1933, pages 543-544. Properties and uses of Al bronzes are described for Al contents from 0-12%. The γ-phase is brittle and alloys can be used only if the γ content of solution is very low. The color is similar to gold for 10% Al, green gold at 7-8%, and pink for lower percentages. Density varies from 8.92 (0.1% Al) to 7.45 (10.78% Al). Mechanical properties are shown in the following table:

% Al	Tensile strength	Elastic limit	Elongation
0	22 kg./mm.^{2}	3 kg./mm.^{2}	55%
3	29 kg./mm.^{2}	5 kg./mm.^{2}	60%
5	35 kg./mm.^{2}	7 kg./mm.^{2}	65%
7	38 kg./mm.^{2}	9 kg./mm.^{2}	63%
9	43 kg./mm.^{2}	11 kg./mm.^{2}	55%
10	45 kg./mm.^{2}	13 kg./mm.^{2}	45%

The following table shows the tensile properties of an alloy containing 9.96% Al over a range of temperature:

°C.	Tensile strength	Elongation at rupture
15	60.0 kg./mm.^{2}	28.8%
200	57.4 kg./mm.^{2}	28.0%
300	52.6 kg./mm.^{2}	40.0%
400	38.8 kg./mm.^{2}	48.0%
500	19.2 kg./mm.^{2}	77.0%

$\alpha + \gamma$-alloys can be rolled, forged and drawn. These alloys are used for screws and bolts, watch parts, meters, jewelry, mirrors, etc. Ha (11a)

The Effect of Low Temperature Heat Treatment on the Microstructure of Cold-drawn Brass Tubes. James Fox. *Mechanical World & Engineering Record,* Vol. 94, Oct. 6, 1933, pages 960-961; Nov. 10, 1933, pages 1087-1089. Gives a summary of research to find the most suitable heat treatment for hard-drawn non-ferrous tubes to eliminate their internal stresses without causing any appreciable alteration in their physical properties. Kz (11a)

Ferrous (11b)

E. S. DAVENPORT, SECTION EDITOR

Variations in Properties when Treating Large Masses. E. F. Lake. *Heat Treating & Forging,* Vol. 20, Mar. 1934, pages 128-130. Investigated variations in physical properties at various depths in a 0.40% C steel axle, 4½ in. in diam. and 4 ft. long. It was soaked for 1½ hrs. at 1475° F., quenched in oil held at a uniform temperature below 100° F., tempered at 750° F. for 1 hr. and then cooled in air. Test-bars were taken from 6 positions, both in the annealed state, before heat treating and after heat-treating. Results of tensile tests showed fairly uniform properties in all specimens from the annealed axle. In the case of the heat treated axle, test bar with its center ¾ in. from the outer surface had highest strength, which was appreciably higher than that of bars closer to the surface. Bar taken midway between center and outside had properties closely approaching those of outer bars. As the center of the axle was approached, there was a decided lowering of strength. Specimen from the center gave values close to those obtained from the annealed axle. Microscopic examination confirmed conclusions drawn from tensile tests that hardening operations had no effect on zones close to the center. Tabulates results of tensile tests. MS (11b)

Results of Comparative Tests of Titanium Treated and other Alloy Cast Irons. G. F. Comstock. *Transactions & Bulletin, American Foundrymen's Association,* Vol. 4, Oct. 1933, pages 278-288. **Alloy Cast Iron with Titanium.** *Foundry,* Vol. 61, July 1933, pages 32-33, 64. A new Ti alloy containing 15 to 20% each of Ti and Si in iron has been developed. Alloy additions of from 0.5 to 2% show that the chief effect of Ti is to decrease the size of the graphite flakes. This generally causes an increase in strength as compared with untreated iron. Four series of tests are reported including physical properties and machining test results. Conclusion is reached that a high-strength cast iron may be made with better machinability and at less cost with Ti and Cr than with other alloys. CEJ+VSP (11b)

The Effect of Titanium on Gray and Malleable Cast Iron (Der Einfluss des Titans auf Grau- und Temperguss) O. Brauer. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Jan. 7, 1934, pages 2-3. Author discusses his experiences with Ti in gray and malleable cast Fe. Gray cast Fe with 0.1% Ti showed excellent casting properties, gave castings with sharp contours and possessed, even in small sections (2 mm. wall thickness), a fine grained uniform structure with fine distribution of graphite. Castings were free from pipe. In using Ti in malleable Fe great care is required since graphite is formed when the Ti content exceeds a certain rather low limit. This is in agreement with statements in the literature that Ti as an alloying element in malleable cast Fe should be used only in small amounts. Advantages of Ti alloyed malleable Fe are pointed out. GN (11b)

Effect of Arsenic and Antimony on Cast Iron (Der Einfluss von Arsen und Antimon auf Gusseisen) E. Piwowarsky, J. Vladescu & H. Nipper. *Archiv für das Eisenhüttenwesen,* Vol. 7, Nov. 1933, pages 323-327. Gray cast irons containing up to 2% As and 1.2% Sb were studied. Small amounts of As increased the bending and tensile strengths but larger amounts lowered them. As increased the hardness and modulus of elasticity and also the resistance to acid attack. As reduced the impact resistance although not as much as P and S; however, in the presence of As the effect of P and S is increased. As seems to have no effect on graphitization but Sb hinders graphite formation and appears to be soluble in cementite. Sb lowers strength and toughness and increases hardness. About 20 to 60% of the As and 10 to 50% of the Sb present in the ore goes over into the pig iron during smelting. Tests indicated that As added to cast iron is not as harmful as that originating in the ore. SE (11b)

The Metallurgy of Iron (Die Metallurgie des Eisens) R. Durrer. Verlag Chemie, Berlin, 1934. Cloth, 6½x9½ inches, 743 pages. Price 96 RM. This is a collection into one volume of the sections on iron of Gmelin's Handbuch der Anorganische Chemie which appeared separately. See *Metals & Alloys,* Vol. 1, Dec. 1930, page 918; Vol. 2, Oct. 1931, page 207; Vol. 3, May 1932, page MA 116; Vol. 4, page MA 96, and page MA 222. H. W. Gillett (11b)-B-

Alloys of Iron and Tungsten. J. L. Gregg. McGraw-Hill Book Company, New York, 1934. Cloth, 6x9¼ inches, 511 pages. Price $6.00. This, the third volume to appear of the monographs in the Alloys of Iron Research program, represents a part of the contribution of Battelle Memorial Institute to the successful carrying out of this program. It is a monumental piece of work which must have required a very great expenditure of labor and time on the part of the author and his immediate associates, and he is to be congratulated upon the clarity of his presentation. Moreover it has had the advantage of the collaboration of a large number, if not of all, the recognized experts in this field, at least to the extent of criticizing, commenting on, and supplementing the original manuscript, in part with material not published elsewhere. The book thus sets forth the best consensus of the present status of knowledge of the system, and is indispensable to anyone who is at all interested in the metallurgy of high-speed steels or of any iron alloy containing tungsten. John Johnston (11b)-B-

Phosphorus in Cast Iron. J. W. Bolton. *Foundry,* Vol. 61, Aug. 1933, pages 16-18, 48; Sept. 1933, pages 16-18, 52, 54. Several years ago author reviewed the effect of P in some detail. Present articles bring subject up to date. Basic and Bessemer pig Fe depend on P and Si content of Fe; Bessemer grades are low P and basic grades are higher P. Line of demarcation for foundry Fe formerly was drawn sharply. Today, Fe's under 0.30% P are used so that both Bessemer and acid open-hearth are finding practical foundry use. In cupola melting, the % of P in molten metal is practically the same as the amount charged. Briefly discusses the work of several other investigators on the subject. P content in pig Fe depends upon the ores used. In gray Fe P is found largely as a eutectic containing 10% P and 90% Fe. Steadite, the P-rich structure, is found as a network in grain boundaries; it is hard and brittle. In commercial Fe Steadite is the last constituent to solidify. Tendency toward shrinkage defects usually is increased by increase in P content. P also lowers content of the eutectic and tendency of Fe to absorb C. Use of lower-P Fe is finding more favor. P is a "nuisance" element, under some conditions relatively harmless, but under others quite detrimental to soundness, machinability, strength and toughness. Includes a number of tables and graphs. VSP (11b)

Molybdenum in Cast Steel. H. W. Gillett & J. L. Gregg. *Transactions & Bulletin, American Foundrymen's Association,* Vol. 4, Oct. 1933, pages 193-198; *Foundry Trade Journal,* Vol. 49, July 13, 1933, page 16; *Foundry,* Vol. 61, July 1933, pages 27, 59-60. In steels of usual carbon content, Mo produces a very marked increase in high-temperature strength. Mo is a specific against "temper brittleness" and in combination with other alloying elements results in high physical properties in the quenched and tempered condition. Mo adds to the ease and certainty of hardening in quenching and aids in the retention of hardness during the removal of casting strains by high temperature tempering. Mo steels usually contain only about .15 to .30% Mo. U. S. supply of Mo is plentiful. CEJ + OWE + VSP (11b)

Vanadium in Steel Castings. Jerome Strauss. *Transactions & Bulletin, American Foundrymen's Association,* Vol. 4, Oct. 1933, pages 225-244. V-bearing steel possesses the ability to sustain stress, or to deform rather than rupture, under suddenly applied overloads. Tension and impact test data are given for a large number of experimental and commercial castings. Large tonnages of C-V steel castings have been used in locomotive construction and in other heavy machinery. V is employed in most of the high-C, high-Cr die steels, in high-C steel rolls along with Cr and in many medium-C cast die steels. CEJ (11b)

Properties and Uses of Some Cast Nickel Alloy Steels. Albert G. Zima. *Transactions & Bulletin, American Foundrymen's Association,* Vol. 4, Oct. 1933, pages 199-224. Properties and uses of 11 type compositions of cast Ni alloy steels are outlined. The data presented are representative of results obtained by many producers. Ni when present in moderate amounts (0.50 to 5.00%) tends to produce a fine-grained ferrite structure and to refine the structure of pearlite areas thus imparting strength, toughness and hardness without decreasing ductility. Ni alloy steels are better adapted for heat-treated castings of large section than plain C steels. CEJ (11b)

Stainless Steel Equipment—Inspection and Repair. C. E. Plummer. *Chemical Industries,* Vol. 33, Nov. 1933, pages 407-409. A discussion of martensitic, ferritic, and austenitic stainless steels and their properties. RAW (11b)

Bessemer Screw Steel Is Improved. *Steel,* Vol. 93, Oct. 23, 1933, page 40. Jones & Laughlin Steel Corp. has developed a steel made in both S.A.E. 112 and high-S grades, involving principally an improvement in free-cutting quality. Chemical composition and physical properties are unchanged from those of the steel which is superseded. Increases in production of 11-99% have been obtained in commercial operation. Physical properties are tabulated. MS (11b)

Nickel Cast Iron. *Engineer,* Vol. 156, Sept. 8, 1933, pages 241-242. Gives facts contributed by the Bureau of Information on Nickel of the Mond Nickel Company, Ltd. Diagrams are given showing strengths obtainable in high-strength cast iron with various proportions of Ni and Si, influence of Ni on structure of average cast iron in various section thicknesses, and influence of heat treatment on strength and hardness of a Ni-Cr cast iron. LFM (11b)

On Cast Iron and Its Properties (Litt om Stöpejern og dets Kvalitets Egenskaper) H. Petersen. *Teknisk Ukeblad,* Vol. 81, Mar. 29, 1934, pages 192-194. Discusses tensile properties of modern high-quality cast irons compared with the older types and points out the possibility of reducing dimensions of castings to save on materials. Argues for the adoption of new standards and specifications for Norway of the same order as those adopted in the United States in 1928 and in Germany in 1929. BHS (11b)

Stabilizing 18-8 Stainless Steel by Addition of Titanium. E. C. Bain, R. H. Aborn & J. J. B. Rutherford. *Steel,* Vol. 92, Apr. 17, 1933, pages 21-23, 25. Paper read before the American Society for Steel Treating. See "The Nature and Prevention of Intergranular Corrosion in Austenitic Stainless Steels," *Metals & Alloys,* Vol. 4, Sept. 1933, page MA 282. MS (11b)

Precipitation Hardening of Copper Steels. C. Stanley Smith & E. W. Palmer. *Iron & Coal Trades Review,* Vol. 127, Aug. 18, 1933, page 239. See *Metals & Alloys,* Vol. 4, Nov. 1933, page MA 342. Ha (11b)

Producing High-Grade Steel Castings for Pressure Work. Fred T. Hays. *Steel,* Vol. 91, Sept. 12, 1932, pages 28, 31-32. See "Pours Steel in Pressure Castings," *Metals & Alloys,* Vol. 4, Dec. 1933, page MA 378. JN (11b)

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"Niresist," a New Heat and Corrosion Resisting Cast Iron ("Niresist," ein neues hitze- und korrosionsbeständiges Gusseisen) J. F. Kesper. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 24, Jan. 28, 1934, page 48. Discusses composition properties, heat treatment and application of this particular cast Fe as primarily developed by International Nickel Co. GN (11b)

Meet Mooring Mast Requirements with Alloy Steel and Welding. A. E. Gibson. *Steel,* Vol. 92, Apr. 10, 1933, pages 21-23, 52. Describes the design and construction of mobile telescoping masts for mooring large dirigibles. MS (11b)

The Effect of Titanium on Malleable Cast Iron (Der Einfluss des Titans auf Temperguss) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Feb. 4, 1934, pages 45-48. In processing malleable Fe containing small amounts of Ti it is advisable to add Ti to the melting charge. Best method is to use Ti-bearing ferro-Si which has a beneficial deoxidizing and degasifying action. One advantage of using ferro-Si is that it permits the use of higher amounts of wrought Fe scrap in the charge. Improvement in quality thus attained seems justified by the higher price of charge. Results of tensile tests on malleable Fe containing .1-.15% Ti are discussed; samples, 12 mm. in diameter, of 12 different heats were tested. Tensile strength averaged 45.8 kg./mm.^{2} and elongation 6.9%, as compared to 32 kg./mm.^{2} tensile and 2% elongation specified for common malleable Fe, and 38 kg./mm.^{2} tensile and 4% elongation for high test malleable. This shows that a Ti content of .1-.15% improves both tensile strength and elongation; machinability of Ti bearing malleable Fe is also much better. Improvement in mechanical properties is due chiefly to fine distribution of graphite. Through the deoxidizing and degasifying effect of Ti, failures due to pipe and porosity are reduced to a minimum. Examples are given for charges of Ti malleable Fe with wall thickness from approximately 3-10 mm. using Ti-bearing ferro-Si. GN (11b)

Influence of Cathodic Hydrogen on the Strength of Steel (Der Einfluss des kathodischen Wasserstoffes auf die Festigkeit des Stahls) D. Alexejew, P. Afanassjew & W. Ostroumow. *Zeitschrift für Elektrochemie,* Vol. 40, Feb. 1934, pages 92-98. The effect of H_2S, SO_2 and As_2O_3 additions to H_2SO_4 on the cathode embrittlement of steel was investigated. Metallographic and X-ray examinations did not reveal any change of structure in steel wire saturated with H as compared to normal wire. The conclusion is drawn that the brittleness is caused by penetration of H in an intercrystalline manner, which also is said to account for the influence of load on duration of polarization. H is assumed to exist in the wire in 2 forms: (1) a loosely bound form which sometimes escapes from the wire spontaneously and can be removed by moderate heating; (2) another form, very likely in solid solution. Brittleness occurs only in the presence of certain additions combined with structural irregularities caused by mechanical working (drawing, etc.). 7 references. Ha (11b)

What Properties are Required in Tool Steels? (Vilka Egenskaper Fordras av Stal för Verktygsändamal?) Kurt Amberg. *Teknisk Tidskrift,* Vol. 64, Feb. 10, 1934, pages 9-11; Mar. 10, 1934, pages 17-24. (With discussion.) Deals with the properties required in various types of tool steels, such as hardness, tensile strength, hardenability and wear resistance. Composition of the most common types are given and the principal properties and uses outlined. Gives the principal considerations in selecting a steel for a certain type of work and discusses some of the typical short-comings. Hardness testing with Widia balls is preferable on these materials, even better than testing with the extra hard steel balls now available. When the steel is exposed to high dynamic stresses its tensile strength is not the only property of importance. Toughness and hardness should be as high as possible to reduce wear to a minimum. Wear resistance is not always a direct function of hardness, however, as for instance in the case of high carbon steels which retain much austenite when hardened from temperatures higher than usual. Failures in tool steels are most commonly the result of wrong temperature in heat treatment. Properties required for drawing tools are high tensile strength under dynamic stress, high hardness, great depth of hardening, resistance to deformation in hardening and good wear resistance. Tools for bakelite molding should have high resistance to fatigue at elevated temperatures, good resistance to oxidation, and great depth of hardening. BHS (11b)

Silal and Nicrosilal Heat-Resisting Cast Irons. A. L. Norbury & E. Morgan. *Transactions & Bulletin, American Foundrymen's Association,* Vol. 4, Oct. 1933, pages 267-277. Silal is a gray cast iron containing about 5% Si and 2.5% total C; it has a fine graphitic structure and a tensile strength up to 44,800 lbs./in.^{2}. The increased Si content greatly increases resistance to oxidation and the iron gives much better service than the best low-Si irons for such purposes as fire-bars, furnace parts, etc. at temperatures up to about 850°C. Silal is brittle and has low impact strength and ductility at temperatures below black heat. At higher temperatures it is quite ductile and does not crack and is considerably stronger than a low silicon iron. Silal can be made in the cupola from ferrosilicon and steel scrap. Nicrosilal is an austentic gray cast iron containing about 2% total C, 5% Si, 1% Mn, 18% Ni and 2-5% Cr. The iron is tough, ductile, resistant to oxidation, easily machined, non-magnetic and has good corrosion-resisting properties; it can be produced in the cupola. CEJ (11b)

Non-Oxidizing Steels (Acciai Inossidabili) Nico Piva. *L'Industria Meccanica,* Vol. 15, Dec. 1933, pages 925-931. Nature and general laws of corrosion are explained and corrosion-resisting steels are described. Composition and structure of the principal stainless steels are given as follows:

Structure	C%	Cr%	Ni%	Mn%	Si%
Martensitic	0.10	14	....	0.40	0.50
	0.20	14	....	0.40	0.50
	0.40	13.5	....	0.30	0.20
Semi-ferritic	0.08	14-15	....	0.30	0.30
	0.05	17-18	....	0.30	0.30
Ferritic	0.10	18	....	0.30	0.30
	0.3	25	....	0.40	0.30
	0.2	30	....	0.40	0.30
Austenitic	0.15	18	8	0.40	0.50
	0.15	18	9	0.40	0.50
	0.20	17	25	0.50	3
	0.30	12	37	0.60	up to 10

Additions of W, Mo, Ti, V, Al, Cu, Zr, are made to obtain certain heat-resisting, machining or other properties. Manufacture of stainless steels is described and particular points to be observed in heat-treatment are discussed. 5 references. Ha (11b)

Chromium in Steel Castings. J. H. Critchett. *Transactions & Bulletin, American Foundrymen's Association,* Vol. 4, Oct. 1933, pages 245-255. Low Cr steels containing 1-3% Cr have a combination of toughness and hardness which makes them suitable for wear-resistant parts. Steels containing 4-7% Cr show strength at moderate temperature, a noticeable increase in corrosion resistance and resistance to scaling at moderate temperature. Steels containing 12 to 20% Cr and upward show marked corrosion- and heat-resistance. Addition of N (as nitrogen ferrochrome) to the extent of 1 part to 100 of Cr increases strength and toughness materially, hardness slightly and has no detrimental effect on machinability. Typical analyses with physical properties and heat treatments are given for all the types of Cr steels. CEJ (11b)

Influence of Phosphorus on the Properties of Hardened and Tempered Cast Iron. J. E. Hurst. *Iron & Coal Trades Review,* Vol. 126, June 9, 1933, page 894; *Foundry Trade Journal,* Vol. 48, June 8, 1933, pages 397-401. See *Metals & Alloys,* Vol. 5, Jan. 1934, page MA 30. OWE + Ha (11b)

Elastic Hysteresis in Crankshaft Steels. S. F. Dorey. *Proceedings Institution of Mechanical Engineers,* Vol. 123, Dec. 1932, pages 479-535. See *Metals & Alloys,* Vol. 5, Mar. 1934, page MA 87. RHP (11b)

Die Material. *Automobile Engineer,* Vol. 23, Nov. 1933, pages 421-422. Discusses "Meehanite," a processed high grade cast iron which is claimed to possess exceptional wearing properties. Brinell hardness as cast is from 200 to 280. Matrix is completely pearlitic or sorbo-pearlitic. Heat treatment for extreme hardness and toughness consists of an oil quench from 1575°F. followed by tempering at 450°F. for 40 minutes. If machining operations are necessary after heat treating, the dies may be tempered at 850°-1,000°F. Table shows tensile transverse and compressive strength, yield point, deflection, Brinell, impact, and modulus of elasticity of "Meehanite" as cast, heat treated, and heat treated and tempered to machinable hardness. Claims considerable saving through the use of this material for dies. RHP (11b)

Temper Brittleness of Common Structural Steels (Etude sur la fragilite des aciers ordinaires de construction) Paul Borel. *Revue de Metallurgie,* Vol. 31, Jan. 1934, pages 14-31. A group of killed steels (.14-.16 C, .23-.30 Si, .99-1.10 Mn, .04 max. S, .008-.020 P) was compared after similar heat treatments with two types of rimming steels (.21-.24 C, .018-.023 Si, .82-.1.10 Mn, .04 max. S, .046-.055 P and .23-.24 C, .04 Si, .38-.60 Mn, .04 max. S, .006-.013 P). Quenching and normalizing from 850°C was followed by drawing at 650°C for different times and followed by different cooling rates. Time at normalizing temperature does not affect the steel. Rate of cooling after tempering is without influence. Open steels have a larger grain size after the same treatment. Quenching before tempering gives better results than normalizing. In killed steels all treatments used produced practically the same impact strength. In open steels the impact value produced by double quenching, from 850°C and 650°C in water, is much greater than when quenching is replaced by air cooling. The structure is independent of the impact strength. Oxygen acts as a catalyzer of germination. JDG (11b)

Low Nickel Cast Steels (Les Moulages d'aciers au nickel à basses teneurs.) F. Renaud. *Aciers Spéciaux Métaux & Alliages,* Vol. 8, Nov. 1933, pages 350-362. The composition of cast steels, of the pearlitic Ni class, used in industries varies within the following ranges:

Mark	Kind of Steel	Ni	Mn	Cr	Mo	V
A	Ni	1.5/3.5	0.6/0.9			
B	Ni-Cr	1.3/4.5	0.6/1.1	0.7/1.6		
C	Ni-Mn	1.0/1.8	0.8/1.5			
D	Ni-V	1.0/2.5	0.6/0.9			0.1/0.3
E	Ni-Mo	1.0/2.5	0.6/0.9		0.2/0.4	
F	Ni-Cr-Mo	1.0/2.5	0.6/0.9	0.5/1.3	0.2/0.6	
G	Ni-Cr-Mo-V	1.0/2.5	0.6/0.9	0.5/1.3	0.2/0.6	0.1/0.3

Silicon varies within 0.15 to 0.40% with S and P below 0.052%. Heat treatment of these steels consists of: Annealing at 850°-980°C., for so-called homogeneity. Annealing in order to relieve the internal stresses due to irregular shapes of castings. Grain refining treatment should be carried out at temperatures in the range 770°-850°C. Hardening treatment is logically preceded by grain refining treatment. Water or oil quench or air cooling may be used depending on the kind of steel. Drawing of the quenched steels is carried out at temperatures below the A_1 or in the range 550°-700°C. A simplified heat treatment for self-hardening steels consists in the homogeneity treatment at high temperature followed by air cooling. Mechanical properties of these steels vary within the ranges given below:

Mark	Steel	Tensile Strength lbs./in.^{2}	Elastic Limit lbs./in.^{2}	Elongation %	Reduction of Area %	Brinell Hardness
A	Ni	78500-92600	50000-64200	25-35	45-60	140-200
B	Ni-Cr	85600-142200	57000-114000	15-25	25-35	200-300
C	Ni-Mn	78500-92600	50000-64200	20-25	25-45	170-230
D	Ni-V	85600-92600	50000-71400	25-35	45-60	180-230
E	Ni-Mo	85600-92600	50000-71400	20-65	45-50	180-250
F	Ni-Cr-Mo	114000-157000	64200-142200	10-25	20-35	250-400
G	Ni-Cr-Mo-V	114000-157000	714000-185400	5-10	10-25	250-500
Carbon Steel		64200-85600	43000-50000	15-25	25-35	130-230

The above properties are representative of the heat treated steels either after a complete heat treatment such as homogeneization, grain refining and hardening and drawing, or after the simplified normalizing and drawing treatment. At temperatures around 500°C. Ni-Cr-Mo steels exhibit better mechanical properties than any of the other steels. Ni-Cr-Mo steels are free of temper brittleness which usually occurs in Ni-Cr steels after heating at 400-660°C. and slowly cooling. Low Ni cast steels are preferably made in open hearth or electric furnaces; in England and United States by the acid process, and in France by the basic process. Soft Ni steel is used for casting chains. The heat treatment of these chains consists in an annealing followed by water quench and draw. Locomotive frames are cast of 2% Ni steel or 3% Ni-1% Cr steels, or Ni-V steels. Rail crossings are cast of Ni-Cr, Ni-Mo or Ni-Cr-Mo steels to withstand wear. Ni-Cr-Mo steel castings are also used for high temperature and high pressure service. GTM (11b)

Study and Classification of Tool Steels (Etude et Classification des Aciers à Outils) H. Godfroid. *La Technique Moderne,* Vol. 25, Mar. 15, 1933, pages 185-192. Actually tool steels are classified according to chemical composition or probable use without taking account of physico-chemical characteristics. Author thinks that steels of quite different chemical composition can have similar properties and that those properties depend chiefly upon structure. In first section of article, equilibrium diagram of C steel is discussed. In second section, equilibrium diagrams of alloy steels are studied taking account of Aall's hypothesis according to which "Each of alloying elements dissolved in gamma Fe, displaces, in a translating motion, lines of transformation diagram of C steel. In this displacement, lines remain parallel to themselves and displacement is proportional to quantity of alloying element dissolved." A table gives coefficients for vertical displacement (respectively + 7, + 8.3, + 58, — 11.5) and horizontal displacement (respectively —0.080, —0.065, —0.300, 0.030) for W, Cr, V and Ni. It would be necessary to establish similar coefficients for Si, Co, Mo, etc. . . . In third section of article equilibrium diagrams for 8 kinds of steels are drawn and explained. A classifying table is suggested for all steels. In this table, steels are placed in 2 classes. Class A for steels having a eutectoid point and comprising: Group 1: Hypo-eutectoid steels. Group 2: Hyper-eutectoid. Group 3: Steels with a portion of the carbides insoluble in the solid state. Class B for steels having no eutectoid point and comprising: Group 1: Steels with all their carbides soluble in the solid state and Group 2: Steels with a portion of the carbides insoluble in the solid state. Structures and uses are given for each group of steels. In last section of the article, high speed steels are discussed. Conclusions of this section are as follows: (1) High speed steel must not contain too high a proportion of carbides if it is to be easily forgeable (C 0.70-0.80%). (2) It must be quenchable at not too high a temperature (about 1300°C.) (3) It must have a sufficiently high content of insoluble carbides for good cutting power, (4) Temperature of solution of carbides must be high for high cutting speeds (at least 1050°C.). FR (11b)

Steels for Cracking-Tubes and Hydrogenation Vessels (Stähle für Spaltrohre und Hydriergefässe) A. Fry. *Technische Mitteilungen Krupp,* No. 1, Feb. 1934, pages 9-12. Materials for oil-cracking processes for temperatures up to 550° C. in the cracking tubes and pressures from 20 to 80 atm. are reviewed. They must be very tough and possess sufficient endurance strength and heat conductivity; chemically they must be resistant to attack by S and gases containing O and S, as well as H and naphthenic acid. Ordinary C and Ni steels did not give satisfaction; Cr steels were much more resistant. A number of tests showed the following results after 144 days, at 130 atm. and 320-420° C.:

Composition

Cr %	Other alloying elements %		Loss of weight g./hr. per m.^{2}	Wear in mm. per year
......	0.25 C	0.5 Si	0.70	0.78
1.5	0.5 Mo	......	0.45	0.50
3.0	......	......	0.32	0.36
6.0	0.4 Mo	......	0.26	0.29
13.0	......	......	0.02	0.02
18.0	9.0 Ni	......	0.05	0.06

American practice with 18% Cr and 8% Ni (non-rusting V2A-steel) is discussed at length. The material for hydrogenation tanks must withstand H up to 600° C. at pressures up to 300 atm. Two methods of producing suitable steels seem to give promise. (1) The C must be bound so firmly in the steel that it resists reduction by H; this was obtained by addition of about 6% Cr or V, with Mo added to give sufficient creep strength. (2) Another way to protect the steel against H-attack consists in eliminating local C segregations, as observed in C steels, by a refining process which distributes the carbides uniformly so that no local cracks are formed even in the case of decarburization. Proper alloying and refining are usually employed together. A micrograph of a steel with 6% Cr and 0.5 Mo shows practically the same fine structure after operating 300 hrs. under attack by H at 300 atm. and 600° C. that it had originally. Ha (11b)

Deep Drawing Sheet Steel. L. B. Hunt. *Automobile Engineer,* Vol. 24, Jan. 1934, pages 25-27. Physical and chemical properties of sheet steel for deep-drawing are discussed. A basic open-hearth steel of the rimming type usually having the composition 0.05-0.10% C, 0.25-0.40% Mn, 0.02-0.04% S, 0.02-0.04% P, and up to 0.05% Si is used. The sheets are hot-rolled with chilled cast iron rolls, the chill extending to ¾ in. depth. After hot-rolling, the sheets are normalized at about 900° C. to remove the effects of hot-rolling and to produce a uniform, fairly coarse-grained structure. The steel must be as free as possible from non-metallic inclusions. Tensile tests are the most reliable guide to the properties of steel sheet, usual values being: maximum stress 20-24 tons/in.^{2}; yield point 12-15 tons/in.^{2}; elongation in 2 in. 35-45%; Rockwell hardness between B40 and B55. The Erichsen test should give normally a minimum of 10.5 mm.; for very deeply drawn pressed parts of about 20 gage, 11 mm. is advisable. A common defect of deep-drawing steel is the occurrence of so-called stretcher or draw strains which is due to occurrence of the yield point in localized portions of the sheet; aging is also related to this phenomenon, as the tensile properties in general are affected. Age-hardening in mild steel may be brought about by presence of minute amounts of impurities or added elements, such as C or N, due to precipitation of finely divided carbides or nitrides within the ferrite grains after heating or deformation. Handling of deep-drawing steels is discussed in general. Ha (11b)

Recent Progress in Development of Alloy Steels (Neuere Fortschritte in der Entwicklung von Sonderstählen) Castner. *Oberflächentechnik,* Vol. 11. Mar. 20, 1934, pages 67-68. It is shown how development of steels for special purposes, as heat-, corrosion-, seawater-resistance, etc., has made great strides since application of the knowledge gained by metallographic and physico-chemical research. Non-rusting steels are now widely used. Special boiler steels with good strength at elevated temperatures have been made by addition of Mo and Si, Cr, Al; they are scaleproof up to 650° C. Nitriding steels have great resistance to fatigue and corrosion fatigue and are used for valves, piston rods, etc.; shafts of nitriding steel have stood 12,000 r.p.m. or peripheral speeds of 20 m./sec. Modern nitriding steels increase in strength in the core during the nitriding process. Nitriding cast Fe is used for cylinder blocks of Diesel engines. A magnet steel of Fe-Ni-Al has recently been developed with a coercive force of 500 oersteds while a silicon steel developed only 0.2-0.4 oersted coercive force. A new steel, Indilatans steel, has an expansion coefficient of only $0.1x10^{-6}$. Forgings of 230 tons weight have been made with full uniform strength to the core. Practical developments in welding and theoretical progress in metallography are briefly reviewed. Ha (11b)

How Alloying Elements Affect Performance. G. K. Herzog. *Machine Design,* Vol. 5, Aug. 1933, pages 35-37. A review of German investigations on the effect of composition and structure on the abrasion of cast Fe. (12 analyses given.) The least abrasion loss is obtained when 2 test pieces are of similar hardness. With increasing hardness the abrasion loss is lowered. The greatest effect on abrasion resistance of cast Fe is exerted by Cr and P. Cr-Ni additions have less effect and Ni alone has but little effect. An increase in Mn increases abrasion resistance slightly, while Si has the opposite effect. The difference in hardness of the stationary and the moving parts is the criterion for the abrasion resistance of high grade cast Fe. Graphite in long thin veins reduces the abrasion loss. 0.4% Cr and over raises the abrasion resistance which gains 25% at 0.7% Cr. No change in wear could be observed for temperatures up to 250° C. except in the case of high P samples which showed a 25% increase in abrasion losses at 250° C. The more exacting the service of a gray cast Fe, the better must be the finish. (Wearing in of pistons!) WH (11b)

Non-aging Iron and Steel for Deep-Drawing. Anson Hayes & R. O. Griffis. *Metals & Alloys,* Vol. 5, May 1934, pages 110-112. Due to non-uniformly distributed strains during yielding in cold working, steels develop uneven surface conditions called "stretcher strains." Cold working slightly and uniformly will eliminate this non-uniform yielding but decreases the ductility somewhat and introduces aging and "blue brittleness" effects. A ferrous material has been produced which has no such characteristics and while no attempt is made to generalize with regard to the essential features of the production of this material, typical analyses are cited and the stabilizing treatment mentioned. The following compositions normalized and held at 1180° F. for 3 hours and cooled 10-15° F per hour will show no aging:

C	Mn	P	S	Si	Ti	Al
0.05%	0.03%	0.005%	0.019%	....	0.067%	0.042%
0.042%	0.47%	0.011%	0.014%	0.073%	0.058%	0.037%

Materials of higher C and Mn without aging characteristics have been produced and Ti and Al may be replaced by other deoxidizers. WLC (11b)

Develops Technique for Fabricating 18-8 Stainless clad Steels. E. C. Kreutzberg. *Steel,* Vol. 93, Sept. 18, 1933, pages 23-26. Ingersoll Steel & Disc Co. manufactures its IngOclad by placing 2 ground, stainless steel plates, separated by an insulating material, with the edges welded over, in an ingot-mold and pouring mild steel around them. This composite ingot is rolled into plates, the ends and edges sheared, and the final plate broken apart to provide 2 plates of stainless-clad steel. Stainless facing usually comprises 20% of the total thickness. Material can be used only where an unbroken stainless surface is required and in heat applications at temperatures lower than 800° F. In general, fabrication is accomplished with the same equipment used for mild steel. Describes working technique under following headings: welding; deep drawing; pickling; dies; lubricants on blanks and dies; heat treating and annealing; riveting; preparation of surface; pickling and passivating; sand blasting; shearing, punching, and drilling; roll forming and braking; grinding and polishing; soldering; brazing and Ag soldering; and protection of polished surfaces during fabrication. MS (11b)

Some Notes on Heat-Resisting Metals. N. P. Inglis. *Journal Society of Glass Technology,* Vol. 17, Dec. 1933, pages 366-377. Developments and improvements in various metals for the purpose of improving their resistance to heat are reviewed. The phenomenon of "growth" in cast Fe and its elimination by alloy additions, of which Cr is the most effective, is discussed; low C-high Si content imparts good heat resistance to cast Fe. Cr is also the best alloy addition for reducing corrosion at high temperatures under both oxidizing and sulphurizing conditions. Reference is made to Cr-Ni austenitic steels and to the benefits of Ti additions to 18-8. Addition of Al reduces susceptibility to gases containing S of the nichrome class of alloys. Experimental and micrographical results are given. Ha (11b)

Steels for Automatics and Headers. Hans Diergarten. *Metal Progress,* Vol. 25, Dec. 1933, pages 44-45. German roller bearing and cycle industries require for screw machines or heading operations cold drawn rod or wire that has uniform machinability, heading properties and response to case hardening. Fine grain and freedom from large, unevenly distributed slag inclusions is desired for machinability. For heading properties an elongation of 10-15% in a length of 10 diameters is suitable. The McQuaid-Ehn test is used as a criterion of response to carburizing. In German practice (1) medium S, high P and Mn, (2) high S basic, and (3) high S acid steels are used. WLC (11b)

Cast Iron from the Electric Furnace. Clyde L. Frear. *Iron Age,* Vol. 131, June 15, 1933, page 95. Comments on the article published in Iron Age May 4, 1933: "Electric Furnace Cast Iron in the Jobbing Foundry," by W. B. Crawford and R. B. Crawford. Points out that the article does not show all the possibilities of the electric process or methods by which improvements may be effected in the properties of gray cast Fe. VSP (11b)

The New Cast Irons and Their Treatment. H. M. Dietert. *Machinery,* N. Y., Vol. 40, Apr. 1934, page 457. Data are given on mechanical properties of Ni-Resist, a Ni-Cr iron with a maximum of 14% Ni and 5½% Cr. This alloy does not grow or scale at temperatures up to 1500° F. and resists acids and alkalis. Mechanite, a specially treated cast Fe containing calcium-silicide to give it the necessary Si range with a low C mix, Duriron and Pyrocast, high Cr cast irons having corrosion resistance, Ni-Hard iron with a surface hardness up to 625 Brinell and Sial, an iron for high temperatures are also discussed. Ha (11b)

Change of Resistance of Nickel, Iron and Bismuth in Alternating Magnetic Fields of Sound Frequencies (Widerstandsänderung von Nickel, Eisen und Wismut in tonfrequenten Wechselmagnetfeldern) J. Mueller. *Zeitschrift für Physik,* Vol. 88, No. 5/6, 1934, pages 277-294. A method for measurements in the range of sound frequencies is described; Fe and Ni but not Bi show a phase difference between magnetic field and magnetic induction. The magnitude of the phase difference depends on the magnetic saturation. Ha (11b)

Permeability of Nickel and Iron at Very Short Wave Lengths $\lambda = 4$ to 10 m. (Permeabilität von Nickel und Eisen bei sehr kleinen Wellenlängen $\lambda = 4$ bis 10 m.) J. Mueller. *Zeitschrift für Physik,* Vol. 88, No. 3/4, 1934, pages 143-160. A thermal method of determining the high-frequency resistance of wires at very short wave lengths is described and its application in determining permeability explained. Frequency apparently has no influence on the permeability of Ni, while that of Fe decreases with increasing frequency, the more so the less the circular magnetization in the interior of the wire. Ha (11b)

Influence of Superheating of Cast Iron of Different Compositions (Einfluss der Ueberhitzung auf Gusseisen verschiedener Zusammensetzung) O. v. Keil & A. Legat. *Die Giesserei,* Vol. 20, May 26, 1933, pages 214-217. Fe-C-Si and Fe-C-Ni cast irons with or without Al additions were investigated with respect to influence of superheating. It was found that not only the sequence of the additions has an influence on the cast iron, but also the time when the addition is made, before or after superheating. Superheating favors metastable solidification and graphite formation. In Fe-C-Si melts which have not been superheated the dependence of critical C content upon rate of cooling must be ascribed to the increased tendency for segregation of graphite due to highly dispersed slag nuclei. Superheating precipitates these nuclei. Mn does not have a stabilizing influence on graphite segregation after superheating. The degree of dissociation of nuclei is of greatest importance as shown in C-Si-Ni melts where in spite of precipitation of large quantities of slag nuclei, all these alloys are of needle-like structure. Ha (11b)

Experiments with Norwegian Vanadium-Titanium Pig Iron (Ueber Versuche mit dem norwegischen Vanadin-Titan-Roheisen) E. Piwowarsky. *Die Giesserei,* Vol. 20, Feb. 17, 1933, pages 61-63. A special pig iron is obtained from Norwegian ores of the following composition: Fe 64.6%; V_2O_3 1.1%; S 0.02%; Al_2O_3 2.0%; TiO_2 1.3%; SiO_2 2.6%; P 0.008%; MgO + CaO 0.9%. The ore is smelted in an electric, charcoal blast furnace and supplies iron with:

$>$ 4.0% C	or	$<$ 4.0% C
0.6-0.7% V		0.6-0.7% V
0.3-0.5% Ti		0.3-0.5% Ti
0.2-0.3% Si		1.4-3.5% Si
0.2-3.0% Mn		0.2-3.0% Mn

Increase in Si is usually accompanied by an increase in Ti. Castings from this iron had excellent wear resistance, tensile strength of 50-56 kg./mm.^{2}, elongation of 4.25%-3.8% and an impact strength of 2.8-1.45 mkg./cm.^{2}; ordinary iron had only 38.5 kg./mm.^{2} tensile strength, 3.6% elongation and 1.43 mkg./cm.^{2} impact strength. The favorable influence of even a few tenths percent of Ti consists in improving the formation of graphite and cleaning the Fe; V stabilizes carbide, increases tensile strength and wear resistance, and deoxidizes the Fe. It is said that it is cheaper to use V-Ti-iron than to alloy cast iron with ferro-titanium and that both elements dissolve quicker and better than when ferro-titanium alone is used. Several applications of this metal, especially in railroad parts, are described. Ha (11b)

Mechanism of Break-down of Steel. IV Effect of Cold Work on the Yield Point Phenomena. V Model Explanation of Yield Point. Masawo Kuroda. *Bulletin Institute of Physical & Chemical Research, Tokyo,* Vol. 13, Mar. 1934, pages 169-177, 178-185. (In Japanese.) *Scientific Papers and Abstracts Institute of Physical & Chemical Research,* Vol. 23, Mar. 1934, pages 15-16, 17. (In English) Experiments on Fe in the as rolled, tempered and fully annealed state and effects of aging at intervals through tension tests. Disappearance of the "palier" or flat region in the stress-strain diagram at the yield point after cold work and its recovery on annealing is interpreted on the basis of the author's previously advanced hypothesis of boundary structure. Tempering at a relatively low temperature eliminates the cold work produced in tension which is considered as some kind of plastic cracking in ferrite. The effect of severe cold work by rolling or by tension such as to produce local deformation cannot be offset by tempering. Only annealing which is accompanied by grain growth can achieve this. The latter phenomenon is caused by "rotation of crystallites into fibrous structure." The increase of strength due to aging after light cold working is ascribed to the production of smaller crystallites while that by severe cold work is due to the elimination of internal stresses. A model of the heterogeneous structure of mild steel composed of ferrite and boundary structure was made of a bundle of soft and hard drawn wires. Their proportion, diameter and material were changed and several pieces were bundled and soldered at both ends. When these test pieces were pulled to the break-down point, the load-elongation curves showed discontinuities identical with those found at the yield point of steel. The length of the "palier" depends on the number of hard wires included. This model experiment suggests that the existence and mechanism of the "palier" at the yield point in mild steel can be explained by the heterogeneous structure theory set forth in the previous papers of the author. WH (11b)

Low Chrome Steels with Molybdenum and Tungsten. Geo. W. Johnson. *National Petroleum News,* Vol. 24, Nov. 16, 1932, pages 29-37. The physical properties of 4-6% Cr; 4-6% Cr with .75-1.25% W; and 4-6% Cr with .40-.65% Mo are given in a series of tables. These alloys have given good service as oil cracking tubes which application is discussed. VVK (11b)

Change of Resistance of Nickel Wire under Tension at Different Temperatures (Veränderung des Widerstands von Nickeldraht beim Spannen bei verschiedenen Temperaturen) S. Arzybaschew & V. Jushkow. *Zeitschrift für Physik,* Vol. 86, No. 7/8, 1933, pages 521-522. Previous results were confirmed by recent experiments. The relative changes of specific resistance at different tensions and temperatures are irregular curves with a minimum. Ha (11b)

Occurrence of a Negative Minimum in the Resistance-Hysteresis Loop of Nickel in Longitudinal Magnetic Fields (Das Auftreten eines negativen Minimums in der Widerstandsschleife des Nickels in longitudinalen magnetischen Feldern) Md. Sharf Alam. *Zeitschrift für Physik,* Vol. 87, No. 3/4, 1934, pages 255-257. This minimum occurs only when the maximum magnetic field used in the magnetizing cycle amounts to about 200 gauss; it does not appear at 500 gauss. Ha (11b)

Chromium and Chromium-Molybdenum Steel (Chrom- und Chrom-Molybdän-Stahl) *Zeitschrift für Flugtechnik und Motorluftschiffahrt,* Vol. 24, July 28, 1933, page 405. Alloys (no composition given) which are thought of as replacing Ni and Cr-Ni steels in automobile, airplane, and motor construction, together with physical properties and heat treatments are tabulated. These alloys are more easily machinable than Ni and Cr-Ni steels. Kz (11b)

Cast Iron, an Old Metal with New Possibilities. *Machinery,* N. Y., Vol. 40, Oct. 1933, pages 93-95. Advances in quality of cast irons (tensile strength up to 60,000 lbs./in.^{2}), in malleable castings and charcoal pig irons, are reviewed. Ha (11b)

Corrosion Resistant Steel—The Metal of a Thousand Uses. *Machinery,* N. Y., Vol. 40, Oct. 1933, pages 72-76. Requirements of unusual character which can be filled by corrosion-resistant steels are discussed generally; tables showing different types of steel on the market with their fields of application are given. Ha (11b)

Using Steel Castings for Strength and Reliability. *Machinery,* N. Y., Vol. 40, Oct. 1933, pages 77-80. Some large Ni steel castings, propellers, axles, etc., up to 27,500 lbs. in weight and with tensile strengths up to 90,000 lbs./in.^{2} are described. Ha (11b)

The Part Played by Alloy Steels in the Machine Age. *Machinery,* N. Y., Vol. 40, Oct. 1933, pages 68-71. Advantages obtained by use of alloy steels in modern machinery, industrial equipment and structures are discussed and illustrated by a few examples. Ha (11b)

Spring Steels (Federstähle) E. Houdremont & H. Bennek. *Technische Mitteilungen Krupp,* No. 1, Feb. 1934, pages 7-9. The report of the Committee of the V. D. I. reviews types of steels used for springs; hardening methods, heat-treatment, testing and properties, and rules of different countries are discussed. It is pointed out that oscillating tests of short duration are valueless as indicators of behavior in service. See also *Metals & Alloys,* Vol. 4, July 1933, page MA 206. Ha (11b)

Influence of Rolling and Annealing upon the Properties of Mild Steel Sheets. C. A. Edwards. *Proceedings South Wales Institute of Engineers,* discussion, Vol. 50, Mar. 13, 1934, pages 39-43; *Usine,* Vol. 43, Mar. 22, 1934, page 27; *Sheet Metal Industries,* Vol. 8, Jan. 1934, pages 9-11; Feb. 1934, pages 79-81. See *Metals & Alloys,* Vol. 5, May 1934, page MA 225. AHE+Ha+AWM (11b)

Intergranular Corrosion of 18-8 Halted by Columbium. Russell Franks & F. M. Becket. *Steel,* Vol. 94, Mar. 5, 1934, page 28. See "Effects of Columbium in Chromium-nickel Steels," *Metals & Alloys,* Vol. 5, May 1934, page MA 224. MS (11b)

Absorption of Hydrogen by Iron (Ueber die Aufnahme des Wasserstoffs durch Eisen) F. Koerber & H. Ploum. *Zeitschrift für Elektrochemie,* Vol. 39, Apr. 1933, pages 252-255. See *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 334. Ha (11b)

The Phenomenon of Heredity in Cast Iron as It Affects Foundry Practice (Il fenomeno dell'eredità delle ghise nella pratica della fonderia) Antonio Lavagna. *L'Ingegnere,* Vol. 8, Mar. 1, 1934, pages 208-211. After remelting, cast irons show mechanical properties different from what might be expected on the basis of chemical composition. The author reviews the theories that have been offered to explain this phenomenon. The degree of oxidation of the remelted iron seems to be a significant factor. Despite advances in the technique of metallurgical analyses in recent years, the phenomenon of oxidation of cast iron is still not completely understood due to difficulties in research and analysis. Presence of other, more readily oxidizable elements has been thought to prevent oxidation of iron in the crucible, but this is not true for the amount of iron present is much greater than that of the other elements. One method for reducing the amount of dissolved oxygen consists of maintaining the temperature of the metal at slightly more than 1400° C. RRS (11b)

The Effect of Nitrogen on High Chromium Steels. S. M. Norwood. *Canadian Chemistry & Metallurgy,* Vol. 18, Feb. 1934, page 36. Large columnar grains in straight Cr alloys containing over 18% Cr have been reduced by the addition of appropriate amounts of nitrogen in the form of high-nitrogen ferrochrome. The nitrogen should be present in an amount equal to about 1% of the Cr content, thereby improving the strength and toughness of the casting without materially affecting the hardness or machinability. One detrimental effect of nitrogen on the properties of wrought Cr-Ni steels is decreased stability at elevated temperatures. These steels are subject to intergranular attack. Nitrogen improves the machinability of Cr-Ni steels and provides non-magnetic castings having relatively high strength. WHB (11b)

The Influence of Silicon on the Structure and Shrinkage of Iron-Carbon Alloys (Ueber den Einfluss von Silizium auf den Gefügeaufbau und die Schwindung von Eisen-Kohlenstoff-Legierungen) A. Merz & E. Issler. *Mitteilungen aus den Forschungsanstalten des GHH-Konzerns,* Vol. 2, Jan. 1934, pages 271-282. The solubility of C in the stable γ-Fe could not be determined when the Si content was 6-10%. This was ascribed to the heterogeneous structure of highly silicized alloys in temperature ranges in which, according to Morschel, homogeneous γ-solid solutions should exist. Acid-proof alloys with 10-23% Si do not show any regular relation between shrinkage and chemical composition, melting treatment or cooling velocity. Ha (11b)

Trend in Requirements for Plain and Alloy Steels. H. W. McQuaid. *Metal Progress,* Vol. 25, Jan. 1934, pages 15-18. Buyers of steel are increasing the number of requirements which must be met by the steel they buy. Steel-makers are being held responsible for the response of their steel to such operations as machining and heat treatment. Grain size and depth of hardness tests have helped to evolve precise specifications but frequently contradictory requirements are specified. Cooperation between metallurgists representing both sides is necessary for working out the proper specifications. WLC (11b)

Malleable Cast Iron as an Engineering Material. C. C. Hodgson. *Machinery,* London, Vol. 43, Dec. 7, 1933, pages 273-279. After dealing with the manufacturing processes, the chemical compositions of white-heart and black-heart irons are discussed as well as the influence which individual elements exert during solidification, cooling and annealing. Structure of malleable cast iron and changes taking place during annealing are discussed by means of photomicrographs illustrating various stages of annealing. Dealing with mechanical properties and testing, the author—referring to numerous test results presented in tables—points out the difficulties of selecting a test piece which shall be truly representative of the casting. Applications are outlined. Troubles and defects encountered in malleable castings and their influence on machining properties are discussed. Kz (11b)

Interrelation Between Adsorption-Active Centers and Catalytic Effectiveness. Measurements on Active Iron (Über den Zusammenhang von adsorptionsaktiven Zentren und katalytischer Wirksamkeit) R. Klar. *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 166, Sept. 1933, pages 273-284. Pursuing previous research on the adsorption potentials of metallic powders (See A. Magnus & R. Klar, *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 334), the adsorption of ethylene, ethane and hydrogen on pure Fe samples of different activities was studied. A direct connection between the magnitude of the adsorption potential and the catalytic efficiency was found and conclusions are set forth regarding the active centers of the metallic Fe samples employed. Tests on Ni are under way. EF (11b)

Titanium in Gray Cast Iron. George F. Comstock. *Iron Age,* Vol. 131, June 1, 1933, pages 857-859, adv. sec. page 12; June 8, 1933, pages 897-900. Discusses practical tests and conclusions drawn from comparative studies of the effect of Ti and other alloys on the same Fe base. Ti alloy used in tests had the following composition: Ti 15 to 20%, Si 15 to 20%, Al less than 1%, C less than 0.5%. Results of tests are consistent in that the Ti treated Fe was stronger than the untreated. Maximum increase in strength from Ti treatment was from 6 to 17%, but this was not true with 2% addition. Graphite particles were finer in Ti treated Fe. Results indicate that when alloy was added in large ladles, a 1% addition was better than 2%. Since Ti promotes formation of ferrite, Cr and Ni were added to counteract this action. Machinability tests were made by O. W. Boston on his tool dynamometer. Cr-bearing Fe treated with 1% Fe-Ti was the strongest according to tests. Ni-Cr and Mo Fe's were distinctly inferior. Gives cost relations of these alloy Fe's. Concludes that increased strength and machinability is best obtained by combining Cr and Ti as alloying materials. Tabulates results. VSP (11b)

Abrasion—Resisting Castings. William C. Hartmann. *Iron Age,* Vol. 132, July 20, 1933, pages 20-21. Describes an abrasion-resisting Cr-Mo alloy steel developed by the Bethlehem Steel Co. The new alloy castings are made from specially melted steel in furnaces operated under close metallurgical and chemical control. Steel is poured into prepared and dried molds, suitably gated and provided with ample heads to insure sound castings. Physical properties will vary from an average of 110,000 lbs./in^2 tensile strength, 60,000 lbs. yield point, 20% elongation, and 30% reduction on a fully annealed piece, to 220,000 lbs. tensile strength on a piece hardened to 400 to 500 Brinell. Gives performance records. VSP (11b)

Announces a New Deep Drawing Steel. *Iron Age,* Vol. 132, July 13, 1933, pages 27-28. Describes a deep drawing sheet metal possessing unusual physical properties developed by the American Rolling Mill Co. In the dead-soft condition it will stretcher strain the same as ordinary mild steel, but this is eliminated by small amounts of temper cold rolling after which it does not show stretcher straining even after aging. It possesses further advantage in that cold rolling does not impair ductility. Compares properties of the new material with mild steel, deep-drawing sheets. VSP (11b)

Special Steels for Castings. R. A. Bull. *Foundry,* Vol. 61, Jan. 1933, pages 21-22, 44; Feb. 1933, pages 15-16, 53. From a paper presented before the Machine Shop Practice division of the American Society of Mechanical Engineers in New York. Outlines results of developments in chemical composition and heat treatment of steel castings. Countless combinations of potentially useful elements may be used that, after proper heat treatments, will provide desirable properties in the castings. VSP (11b)

On the Viscosity of Molten Pig Iron (Ueber die innere Reibung von flüssigem Roheisen) H. Esser, F. Greis & W. Bungardt. *Archiv für das Eisenhüttenwesen,* Vol. 7, Jan. 1934, pages 385-388. A pendulum type viscosimeter is described and data given on the change of viscosity with temperature of various gray irons. SE (11b)

Some Experiments on the Resistance to Wear of Nitrogen Hardened Cast Iron. J. E. Hurst. *Engineering,* Vol. 137, Jan. 12, 1934, pages 50-52; *Automobile Engineer,* Vol. 23, Nov. 1933, pages 423-425; *Engineer,* Vol. 156, Oct. 6, 1933, pages 337-338. See *Metals & Alloys,* Vol. 5, May 1934, page MA 224. LFM+RHP (11b)

Some Metallurgical Aspects of the Present Production of Steel and Other Ferrous Castings. R. A. Bull. *Metals & Alloys,* Vol. 5, Jan. 1934, pages 1-4. The ambiguity of present terms for castings is discussed and the necessity for a revision of our ideas of the meaning of gray iron, malleable iron, and steel as applied to castings. The great variety of alloy castings increases this confusion. The A.F.A. and A.S.T.M. efforts toward classification and standardization of specifications is discussed. A.S.T.M. specifications cover 7 gray irons, 2 malleable irons and 14 steels. This number is being constantly increased as the importance of other members of the 75 or more alloys at present produced becomes apparent. WLC (11b)

Characteristics of Free-Cutting Steels for Hardening. H. Diergarten. *Metal Progress,* Vol. 25, Jan. 1934, pages 41-42. It is stated that for free-cutting steels Si has an important effect upon machinability, and relation of C to Mn affects the hardening technique. If greater emphasis is placed upon hardenability and rivetability with reduced machinability Si 0.20% is preferred but for maximum machinability it should be held to traces. Mn should be high enough to take care of the S content as MnS. Mn content also affects the viscosity of the molten steel and consequently the elimination of gases. If not over 0.50% Mn the steel is apt to be very sluggish. The McQuaid-Ehn test should be used to obtain uniformity. WLC (11b)

Semi-stainless Steels Apso and Durapso of Pompey Steel Company (Les aciers semi-inoxidables Apso et Durapso des acieries de Pompey). *Genie Civil,* Feb. 1934, page 114. These open hearth steels occupy an intermediate position between stainless and common steel in their resistance to corrosion. Apso is a Cu steel which is made in two hardnesses. The softer has tensile strength of 50,000-55,000, elastic limit 34,000 min., elongation 30% and Mesnager impact 180 ft.-lb. min. The harder one has 56,000-63,000 tensile strength, 36,000 min. elastic limit, 28% min. elongation. Durapso is a Cr-Cu steel having 75,000-90,000 tensile strength, 50,000 elastic limit, 20% elongation and 108 ft.-lb. Mesnager impact value. JDG (11b)

The Work of the Alloys of Iron Research Committee. C. H. Desch. *Iron & Coal Trades Review,* Vol. 128, May 25, 1934, page 835. Some phases of the work of the Committee are described. Special attention was paid to the preparation of pure metals used in making alloys. Fe was purified electrolytically in a solution of purified ferrous chloride with an anode of ingot iron. Cr was especially difficult to obtain pure; electrolytic refining under special conditions was resorted to with subsequent melting in vacuum. Mn was purified by distillation, Si by purely chemical methods. The melting point of pure Fe was redetermined to 1527° ± 3°C., of pure Cr to 1830°C. "Stainless" iron consists essentially of Fe and Cr; the 2 metals form a continuous series of solid solutions at high temperatures, the existence of a compound has not been confirmed. Fe-Mn alloys contain the austenitic steels, especially Hadfield's Mn steel containing some C. Mn is an essential constituent in modern high-tensile structural steels and also in those intended for free-cutting properties. Ha (11b)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (12)

L. JORDAN, SECTION EDITOR

The abstracts in this section are prepared in co-operation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M.

Strength of Steel, Cast Steel and Cast Iron at Low Temperatures (Festigkeitseigenschaften von Stahl, Stahlguss und Gusseisen in der Kälte) W. Ralle. *Zeitschrift für die gesamte Kälteindustrie,* Vol. 40, Oct. 1933, pages 161-162. 0.1 C steel becomes more and more brittle with decreasing temperatures and shows no elongation at liquid air temperature while the hardness increases 3 times over room temperature hardness. The physical properties show no conclusive trends with varying C contents. The location of the elongation maximum is strongly affected by variations in the composition. The increase in hardness at low temperatures is more pronounced for Ni and Cr steel than for W, Mo and V steels. Pure Mn steels are very brittle at -180° C. but a steel with 14% Ni and 5% Mn exhibits remarkable elongation at liquid air temperatures. Cast steel increases in tensile strength, yield point and hardness with decreasing temperatures which have little effect upon cast Fe. The gain in strength at –100° C. is only 14-16% of the strength at + 20° C. Bending strength is hardly affected by low temperatures (+ 8.1%) except in the case of P-bearing cast Fe. The failure of cast parts is attributable to stresses due to shrinkage rather than to losses in strength. EF (12)

Apparatus For Comparison of Length of Gages. Charles Moon. *Bureau of Standards Journal of Research,* Vol. 10, Feb. 1933, pages 249-255. Apparatus has been built for comparing spherical-ended gages of quartz having very small thermal expansion with standard flat-ended gages of steel which have a relatively large coefficient of expansion. The difference in length of 2 gages is measured by a micrometer screw which is driven by a very small reversible electric motor. Screw settings are made automatically by means of an electrical contact indicator which disengages an electromagnetic clutch at a definite measuring pressure. The gage-holding device is made so that the alignment between the measuring faces can be accomplished with the operator at a distance. Hence, the whole operation of length comparison can be made in an inclosed space where the temperature can be accurately controlled. The gages are supported on steel balls which allow the easy endwise motion necessary when using light measuring pressures. The sensitivity of the indicator is such that settings are repeated to within 0.1 μ or 1 part in 1,000,000 on gages 10 cm. long. WAT (12)

A New Device for Creep Testing. F. H. Norton & J. A. Fellows. *Metal Progress,* Vol. 24, Oct. 1933, pages 41-43. Describes with a drawing a furnace for creep testing now in use at Mass. Inst. of Tech. The extensometer consists of two telescopes rigidly joined which are sighted on the gage marks thru peep holes in the furnace and adjustments made with a micrometer screw. The instrument is entirely external to the furnace and accuracy to 0.00004 in. can be attained. By automatic control the temperature of the furnace can be maintained at ± 0.5° F. Variations along the gage length are given as 3° F. WLC (12)

Contribution to the Development of Heat-Resisting Alloys (Contribution au Développement des Alliages Résistant à la Chaleur) E. Piwowarsky. *Mitteilungen aus dem Giesserei-Institut der Technischen Hochschule Aachen,* Vol. 3, Jan. 1934, No. 16, 8 pages. A survey and compilation of heat-resisting steels with their trade names, compositions and characteristics. A test method for determining heat resistivity is described. Ha (12)

Development of Regenerative Heaters in France (Le Developpement en France des Réchauffeurs d'Air Régénératifs) André Liebaut. *Chaleur et Industrie,* Vol. 14, Oct. 1933, pages 479-486. Description of heater of Ljungström type. A section of the article deals with corrosion of heaters; it is shown that corrosion is less in this regenerative heater than in common recuperative heaters because the same metal surfaces are alternatively subjected to hot fumes and cooling air. FR (12)

Magnetostrictive Alloys with Low Temperature Coefficients of Frequency. John McDonald Ide. *Proceedings Institute of Radio Engineers,* Vol. 22, Feb. 1934, pages 177-190. A study of 34 magnetic alloys of Fe, Ni, Cr, and Co was made with rods of these alloys used as secondary frequency standards, to stabilize the frequency of magnetostrictive oscillators. The temperature coefficient of frequency is shown to be a function of composition, heat treatment, temperature, and magnetization. Seven alloys gave temperature coefficients of the order of one cycle in a million per °C., when properly heat treated and magnetized. Five alloys showed large magnetostriction and gave good frequency stabilization when used with a carbon magnetostriction oscillator. All alloys contained Ni and Fe, with Cr and/or Co included. The best results were obtained with the following contents: Cr 8-10%, Ni 36-38%, and the remainder Fe together with 1% Mn to facilitate forging. WHB (12)

Investigations at Lowest Temperatures (Über Untersuchungen bei den tiefsten Temperaturen) W. H. Keesom. *Zeitschrift für die gesamte Kälteindustrie,* Vol. 40, Apr. 1933, pages 49-54; May 1933, page 79. Paper before the General Meeting of the Deutscher Kälteverein, 1933, describes the testing apparatus with which the lowest temperature of 0.71° K. has been attained so far and presents data (diagrams) on measurements with Ag, Sn, Zn and He. EF (12)

The Selection of Materials for High Pressure and High Temperature Work in Refineries. V. T. Malcolm. *Oil & Gas Journal,* Vol. 31, Oct. 13, 1932, pages 14-16. Before Mid Continent Section American Society Mechanical Engineers. A general discussion. VVK (12)

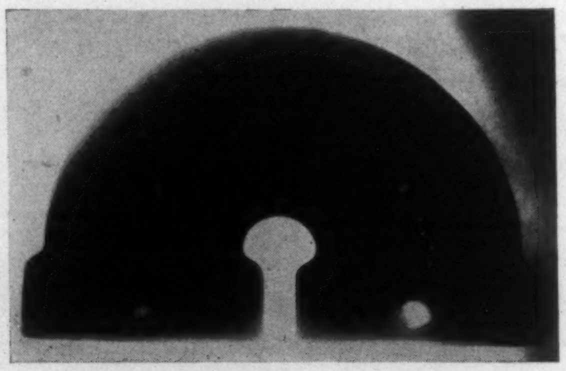
Stresses in Screws at Elevated Temperatures (Beanspruchung der Schrauben bei hohen Temperaturen) G. Krüger. *Die Wärme,* Vol. 57, Feb. 10, 1934, pages 81-85. The types of stresses occurring in screws exposed to elevated temperatures are pointed out and theoretically evaluated. The effect of changes of modulus of elasticity, thermal expansion, flange elasticity and initial stresses upon stresses at higher temperatures is considered and the theoretical derivations applied to the practical utilization of screws. EF (12)

The Effect on Various Steels of Hydrogen at High Pressures and Temperatures. N. P. Inglis & W. Andrews. *Engineering,* Vol. 136, Dec. 1, 1933, pages 613-614. From paper read before the Iron & Steel Institute, Sept. 1933. See *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 160. LFM (12)

Studies on a Modification of the Rohn Test for Investigating Creep of Metals. C. R. Austin & J. R. Gier. *Proceedings American Society Testing Materials,* Vol. 33, Pt. 2, 1933, pages 293-307. The Rohn method for testing metals at high temperatures provides an automatic downward adjustment of temperature in response to creep in the test specimen as well as temperature regulation after the manner of a dilation thermometer. The apparatus described produces a constant temperature over a 20-inch length of test rod with a steep gradient toward each end of the furnace. Test data are given on a very pure iron. VVK (12)

"Checked and Double Checked"
BUT
"The 'Eyes' Do *Not* Have It"

Photograph of Corrosion-Resistant Casting



Radiograph of Same Casting

The Human Eye is Good
The Camera Lens is Better
BUT
The X-Ray Tube Surpasses *Both*
BECAUSE

It Reveals the Presence of DEFECTS, such as shown above, which "ORDINARY INSPECTION METHODS" would approve as "SATISFACTORY."

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Thermalloy
X-RAYED CASTINGS FOR
HEAT CORROSION
ABRASION

Durimet propeller agitators.

An Alloy

For sulphuric acid under oxidizing conditions: for all concentrations of sulphuric acid, including oleum, at room temperature; for boiling up to 15% concentration with or without oxidizing salts; for 90% to concentrated at 200°F.

That's *DURIMET*—a nickel-chromium-silicon *low carbon* alloy steel. Many standard items of mechanical handling equipment are made in it such as pumps, valves, pipe fittings, as well as special castings such as illustrated.

An Alloy

For sulphuric acid under non-oxidizing conditions: for concentrations up to 80% at 200°F. and up to 60% at 250°F.

That's *ALCUMITE*—a copper base aluminum-iron alloy. It is a satisfactory alloy for a number of other acids, including many organic acids, hydrobromic acid, hydrofluoric acid and hydrofluosilicic acid. In it, too, are produced pumps, valves, pipe fittings and other standard items as well as special castings and hot rolled rod.

If you have a corrosion problem that is causing you some trouble in solving, perhaps one of these alloys will solve it for you.

NRA

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Manufacturers of Corrosion-Resisting
DURIRON DURICHLOR
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DURIMET ALCUMITE

Creep and Fatigue Tests of 18 and 8 Steels. H. C. CROSS. *Iron Age,* Vol. 132, Dec. 28, 1933, pages 25, 62. Abstract of a report of the joint research committee of the American Society of Mechanical Engineers and the American Society for Testing Materials to the recent annual meeting of the American Society of Mechanical Engineers. Report covered a comparison of resistance to prolonged loading (creep) and to repeated stress (fatigue) of 18% Cr, 9.5% Ni, 0.5% Mn and 0.6% Si steels of low and high C contents, 0.067% C in the one case and 0.125% C in the other. VSP (12)

Heat Resisting Alloys. D. EVANS. *Metals & Alloys,* Vol. 4. Oct. 1933, page 166. Comment on article of L. J. Stanbery. *Metals & Alloys,* Vol. 4, Sept. 1933, pages 127-135. WLC (12)

What Steel to Use at High Pressures and Temperatures. JOHN L. COX. *Chemical & Metallurgical Engineering,* Vol. 40, Aug. 1933, pages 405-409. Contains bibliography. Based on paper before American Institute of Chemical Engineers, June 15, 1933. A general discussion of metals used for resistance to creep, to hydrogen and to nitrogen and to ammonia. PRK (12)

Physical Properties of Metals at Low Temperatures (Die mechanischen Eigenschaften von Metallen bei tiefen Temperaturen) *Die Metallbörse,* Vol. 24, Jan. 20, 1934, page 83. Discusses experiments of E. W. Colbeck and W. E. McGillivray between +20°C. and —180°C. See *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 160. EF (12)

Lead Bronzes in Automobile and Aircraft Motor Construction (Abermals: Bleibronzen im Automobil- und Flugmotorenbau) MAX ARMBRUSTER. *Deutsche Motorzeitschrift,* Vol. 10, Dec. 1933, pages 240-249. Continuation of a controversy between Semmler (*Metals & Alloys,* Vol. 5, Jan. 1934, page MA 14) and Armbruster who states that Sn-base and Pb-base bearing metals do not meet the requirements of service in highly stressed motors in regard to stability and endurance strength at elevated temperatures. Cu-base bearing metals exhibited fatigue strength which was twice that of high-grade Sn-base bearing metals and 3 times that of Pb-base bearing metals. The hardness of Cu-base bearings must be below 30-36 kg./mm.^{2} otherwise excessive temperature rise will occur in the bearing. Diffusion in the solid state taking place between the bearing metal and its backing is upheld. EF (12)

Cooperative Short-Time High-Temperature Tension Tests of Carbon Steel K6. Appendix I of Report of Joint Research Committee on Effect of Temperature on the Properties of Metals. H. F. MOORE, J. W. BOLTON & J. J. KANTER. *Proceedings American Society Testing Materials,* Vol. 33, Pt. I. 1933, pages 213-217. As a trial of the proposed Tentative Method of Test for Short-Time High-Temperature Tension Tests, specimens from the same heat of an acid open-hearth carbon steel, containing .28% C, .66 Mn, .35 Si, .035 P and .040 S, were sent to three separate laboratories for tension and hardness tests. Results are presented in the form of curves. **Appendix II. The Determination and Significance of "Proportional Limit" and "Breaking Strength" in Short-Time High-Temperature Tests.** H. F. Moore et al. Pages 218-224. Determination of proportional limit is affected by sensitivity and accuracy of testing machine, sensitivity and accuracy of extensometer, variation of time allowed for reading extensometer, scales used in plotting curve, and technique and instruments used in drawing curve, or tolerance allowed if departure from proportionality is obtained from a table of values, differences and second differences. In the data of Appendix I there is a wider variation in results for proportional limit than for any other quantity, except, possibly, breaking strength at high temperatures. Types of stress-strain diagrams are given and it is concluded that "It seems that even a very delicately determined proportional limit for a metal has little, if any, definite significance as an index of strength or weakness. This is in contrast to a fairly well defined yield strength which indicates the limiting stress below which serious structural damage due to permanent distortion will not occur." The determination of proportional limit was therefore not included in the tentative method for short-time high-temperature tension tests. "In tests at high temperatures the difficulty of determining breaking strength is markedly increased. The actual point of fracture is less certain and at best the value reported for breaking load is the operator's estimate of the load at the instant of fracture. In view of the practical impossibility of the accurate determination of the breaking load, determination of breaking strength has also been omitted from the tentative method for short-time high-temperature tension tests." **Appendix III. The Significance of the Results of Short-Time High-Temperature Tension Tests.** H. F. Moore et al. Page 225. No correlation has as yet been developed between short-time high-temperature tension tests and creep at high temperatures. Same is also true of fatigue tests. "In general, short-time high-temperature tests have a narrower field of usefulness than do short-time tests at room temperature. Room temperature tests give data of significance both for occasional short-time loads and for continued loads since, except in the case of very soft metals, creep at room temperatures seems to be not appreciable. Short-time high-temperature test results seem to be significant under conditions of occasional loading where the cycles of load are comparatively few in number and the total duration of the load period is only a few hundred hours." VVK (12)

Low Temperature Impact Tests on Medium Manganese Steel Plate. H. W. HIEMKE & W. C. SCHULTE. *Metals & Alloys,* Vol. 5, Feb. 1934, pages 31-36. Master thesis, University of Wisconsin. The authors summarize three laws regarding cleavage fracture (non-ductile) of steel: (1) increasing velocity decreases the energy of rupture until a non-ductile fracture is obtained. (2) increased width of specimen reduced the energy required to rupture a unit cross-section, (3) decreasing temperature has a like effect to that of increasing velocity. WLC (12)

Strength of Steels at Low Temperatures (Die Festigkeit von Stählen bei tiefen Temperaturen) G. GRUSCHKA. *Zeitschrift Verein deutscher Ingenieure,* Vol. 78, Mar. 24, 1934, page 393. Behavior of structural steels at low temperatures as a function of their composition was investigated. Notch-toughness was almost the same and very low from low temperatures up to –50° C.; above this temperature it rises to a maximum at about 100° C. and then decreases again. Yield point and tensile strength increase with decreasing temperature in C steels and Ni alloy steels, the linear relation between tensile strength and C content which exists at normal temperatures is maintained also at low temperatures. The curves of reduction of area and of elongation show a discontinuity which occurs at different temperatures depending on composition of steels. Addition of Ni shifts this discontinuity to lower temperatures than those in C steels so that hereby the lowest temperature is indicated for which a certain alloy steel can be used in a structure. Ha (12)

Austenitic Steels at Low Temperatures. *Engineer,* Vol. 155, June 2, 1933, pages 556-557. From a paper read by E. W. Colbeck, W. E. MacGillivray & W. R. D. Manning before the Institution of Chemical Engineers, May 1933. See "Mechanical Properties of Austenitic Stainless Steels at Low Temperatures," *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 148. LFM (12)

The Creep Strength of Welds at 400° C. (Die Dauerstandfestigkeit von Schweissungen bei 400° C.) C. APPALY. *Metallwirtschaft,* Vol. 13, May 4, 1934, pages 320-322. Boiler plate, .09% C, 14 mm. thick, was electric metallic arc welded with a good quality heavily coated wire of similar composition. Creep strength tests were made at 400° C. on the wire as received, on remelted wire, on the boiler plate as received, and on the welded boiler plate. None of the materials were annealed. The welded samples had a higher creep limit than the original boiler plate. According to one system of calculating the creep limit of the steel was 11.5 kg./mm.^{2} and of the weld 13 kg./mm.^{2}, according to another 9.5 and 11.5 kg./mm.^{2} resp. The remelted wire had a lower creep limit than the unwelded steel. CEM (12)

CORROSION & WEAR (13)

V. V. KENDALL, SECTION EDITOR

Corrosion in Sulphonators. *Chemical & Metallurgical Engineering,* Vol. 40, Aug. 1933, page 409. Plant Test with International Nickel test specimens showed the following:

Corrosion Rate Mg./dm.^{2}/batch
66° Be H_2SO_4 7 Hr. 34°C.
NaCl Sol. over night

	Neatsfoot oil	Castor oil
Pb	127	165
18/8	425	22
Ni	30	25
Monel	34	11
Ni-Resist	90	29
Cast Iron	10,000	120

PRK (13)

The Effect of Sulphur on Aluminum Cars. *Railway Mechanical Engineer,* Vol. 108, Mar. 1934, pages 83-84. S and S-containing ores and coals were transported in Al cars as a trial which, over the short time that they have been in service promises well as no appreciable corrosion was noted while ordinary freight cars showed great wear by corrosion. Ha (13)

Should Copper be Tinned? (Soll man Kupfer verzinnen oder nicht?) L. W. Haase. *Gesundheitsingenieur,* Vol. 56, Dec. 16, 1933, pages 593-595. Sn coated Cu pipes are recommended for only very soft cold water high in CO_2 and low in O_2 since these waters dissolve traces of unprotected Cu which affect the taste of the water carried. Heat treatment of Sn coated Cu results in the formation of an alloy. This is more electropositive than Sn and thus causes the latter to dissolve. A very low Pb content must be observed in Sn utilized for coating of Cu pipes. Pb tends to dissolve as the anode of a Pb-Cu galvanic cell. Higher Pb contents in the Sn coating reduce its porosity and brittleness. Damage to the Sn coating results in the formation of a Cu-Sn element. The former goes into solution at first and protects the Cu. But O_2, CO_2 and Ca salts attack the Sn and form a layer more electropositive than Cu, so that the Cu then dissolves. In contact with water containing much O_2, CO_2 and Ca salts, Sn coated pipes deteriorate at a faster rate than unprotected Cu pipes. WH (13)

The Behavior of Copper and Zinc and Their Alloys Toward Tap Water (Das Verhalten von Kupfer und Zink und ihren Legierungen gegenüber Leitungswasser) L. W. Haase. *Gesundheitsingenieur,* Vol. 56, Dec. 9, 1933, pages 577-582. Thin walled brass tubes are unsuited for carrying drinking water. Water containing dissolved O_2 will dissolve out Zn due to the galvanic element effect of Cu and Zn. Metal coatings even if correctly selected in electrochemical regard do not always furnish a protection due to the formation of lime bearing incrustations and subsequent pitting. Zn of galvanized Fe goes into solution especially in soft water. Cu tubes are highly independent of the chemical composition of the water carried due to the formation of a protective tenacious cuprous oxide film. This process takes years in the atmosphere, about a week in cold water and less time in hot water. O_2 must be present. Verdigris is not identical with patina (basic copper salts). The latter develops after cuprous oxide has been formed. It does not furnish a protection but tends to accelerate the solution of Cu. The same holds true for Cu carbonate. The formation of the beneficial Cu_2O film can be artificially promoted by adding bicarbonates, nitrates or nitrites to the water. The making of brass and Cu pipes and joining methods are discussed. The protective action of Sn and Zn is considered. Corrosion of the more base metal may "enoble" the metal coating, reverse the potential difference and thus favor the solution of the other metal. WH (13)

How to Avoid Corrosion of Air Conditioning Equipment. Wayne H. Carter. *Chemical & Metallurgical Engineering,* Vol. 41, Mar. 1934, pages 140-142. Corrosion of air conditioning equipment depends upon: (1) fresh water composition, (2) absorption of impurities as CO_2, SO_2, SO_3, (3) saturation of water with air, (4) impingement of high velocity spray on metal surface, (5) dissimilar metals in contact. Water circulated in system should be periodically examined for pH, silica, iron, alumina, lime, magnesia and zinc or copper, chloride, sulphates, carbonates, bicarbonates. With proper water treatment, galvanized iron is satisfactory, plain iron or steel is not acceptable. The pH value of water in galvanized iron equipment should be about 8.5-9. Treatment of water to form protective coatings includes the use of NaOH, Na_2SiO_3, Na_3PO_4, $Na_2Cr_2O_7$, in proper combination. Rubber, asbestos or pressed paper is used as insulators to separate dissimilar metals. Iron oxide carried over from the boiler and deposited upon Cu tubes leads to pitting. PRK (13)

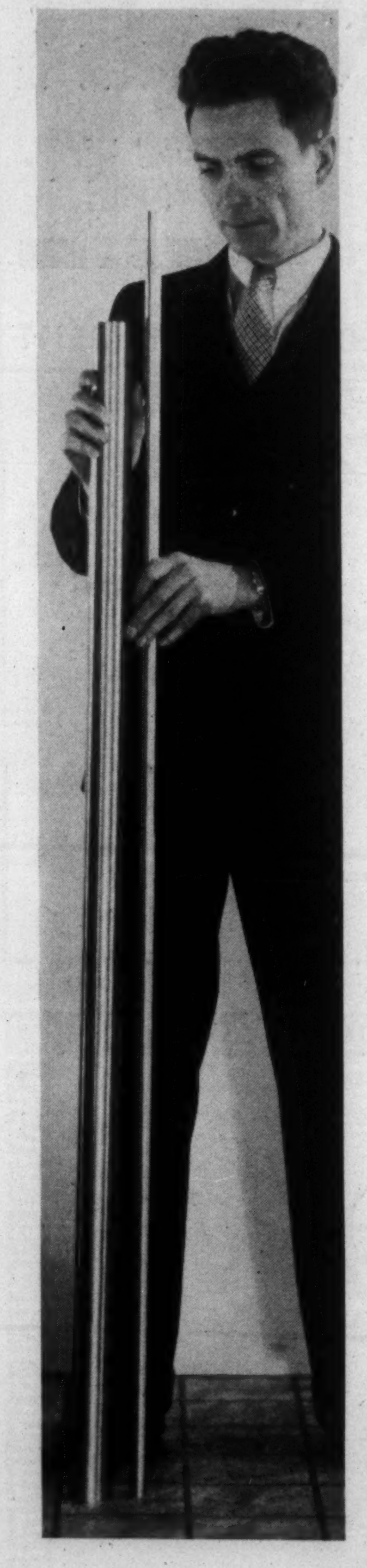
The Corrosion of Zinc in Various Waters. E. A. Anderson, C. E. Reinhard & W. D. Hammel. *Journal American Water Works Association,* Vol. 26, Jan. 1934, pages 49-60. 16 references. The question of the safety of using zinc in contact with drinking water, particularly chlorinated water prompted the investigation. It was found that: chlorinated drinking water is not abnormally corrosive to zinc; distilled water is strongly corrosive to zinc in the sense that in seven days sufficient zinc had been taken into solution and suspension to make it unfit for drinking purposes; the addition of from 1 to 5 parts per million of chlorine to distilled water greatly reduces the rate of attack on zinc and eliminates the health hazard; chlorine added to water is quickly converted into fixed chloride. VVK (13)

The Effect of Water on Iron Pipes. John R. Baylis. *Proceedings American Society Municipal Engineers,* Vol. 39, 1933, pages 177-183. A brief review of the theory of corrosion, the formation and building up of tubercles, and their destruction. WHB (13)

Blowing Mains and Services Free of Rust. Hugo N. Johnson. *Gas Age-Record,* Vol. 72, Oct. 21, 1933, page 393. Part of Safe Gas Distribution Practice Sub-Committee Report presented before Pacific Coast Gas Association, Los Angeles, Sept. 1933. Description of portable dust trap used in blowing gas mains and services free of rust. The exit blowing air is passed through water and then through burlap. Apparatus is said to be efficient and practically noiseless. VVK (13)

Promiscuous Electric Grounding on Water Service Pipes and Mains. N. S. Hill, Jr., C. F. Meyerherm & M. W. Cowles. *Journal American Water Works Association,* Vol. 25, Oct. 1933, pages 1418-1429. Examples are given of trouble from corrosion and color, odor and taste of water due to the presence of stray alternating and direct current on water pipes when the latter were acting as electric grounds. VVK (13)

French Chemical Industries Use Cast Iron in Resisting Corrosion. A. Matagrin. *Chemical & Metallurgical Engineering,* Vol. 40, Sept. 1933, pages 480-482. This is a discussion of the cast irons used in France. For ordinary cast iron, P should be low, 0.04-0.03%; Mn around 0.5-0.6; if too high, acids and alkaline solutions attack it. Si about 1.5% but 4% Si improves resistance to atmospheric corrosion. 0.25% Al and Cu are sometimes added to high Si alloys, where 14.3% Si is usual. Ra alloy has lower Si, good mechanical properties and resistant to dil. H_2SO_4. American Mechanite runs 1-24% Si. Rossi uses 20-21% Si to secure resistance to HCl. 16.92% Si is better than Cu and Pb against acetic acid but not as good as Sn; also fairly resistant to HNO_3 and H_2SO_4, but not HCl or alkali sol. Elianite, 15% Si, is used in picric acid. Ni additions are discussed. 1-1.5% Ni is used for resistance to alkalis. Austenitic C.I. resists high temp. but is not as good for alkali and is worse for HNO_3, but resistant to 5-20% HCl, 25% AcOH, 5-60% H_2SO_4. PRK (13)



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Between Wind and Water. Q. B. Newman. *Marine Engineering & Shipping Age,* Vol. 39, Mar. 1934, pages 96-97. Deals with corrosion at sea and protective coatings. Practical examples and experiences such as why cast iron of pumps has been immune to oxidation when the corrosion-resisting bronzes were rapidly destroyed, are discussed. Remedies for corrosion of boiler, propeller and condenser tubes are suggested. Kz (13)

Protection against Corrosion in Hot-Water Installations (Korrosionsschutz bei Warmwasser-Versorgungsanlagen) Erich Naumann. *Zeitschrift Verein deutscher Ingenieure,* Vol. 78, Apr. 14, 1934, pages 472-476. General points to be observed in selecting a proper system and suitable materials for a hot-water installation are discussed. Causes of corrosion, as effect of air, CO_2, O, the various types of corrosion, value of protective coating, water-heating systems, etc., are dealt with. Ha (13)

Some Observations on the Corrosion of Lead. A. H. Loveless, T. A. S. Davie & W. Wright. *Metal Industry,* London, Vol. 42, June 16, 1933, pages 614-616. See *Metals & Alloys,* Vol. 5, Mar. 1934, page MA 82. Ha (13)

Water Blending for Steam Plant. E. I. Lloyd. *Mechanical World & Engineering Record,* Vol. 94, Oct. 20, 1933, pages 1004-1005. Discussion of the blending of two or more entirely different waters to combat scale formation, corrosion, and embrittlement in boilers. Kz (13)

Corrosion Resistance of Structural Aluminum. E. H. Dix, Jr. *Metal Industry,* London, Vol. 43, Nov. 10, 1933, pages 467-469; *Proceedings American Society Testing Materials,* Vol. 33, Pt. 2, 1933, pages 405-412. A comparison of 1 yr. and 2½ yr. accelerated test (alternate immersion in 3.5% sea-salt) of full-size beams and columns of duralumin type alloy (containing 4% Cu, 0.5% Mn, and 0.5% Mg) with 1, 2, and 5-year outdoor exposure test on thin tensile specimens yielded the following conclusions. Corrosion of duralumin type alloy, 17ST, is practically self-stopping and the depth of penetration is independent of the thickness of the section. Therefore, tension tests on thin specimens after exposure to short-time test conditions give an entirely misleading conception of the corrosion resistance of heavier sections, unless properly interpreted. Such tests, however, are of considerable value when correlated with service experience. After exposure to various corrosive conditions, the yield strength is less affected than the tensile strength and the losses in tensile and yield strengths and elongation tend to approach a limit below which they do not drop appreciably, even when the exposure period is doubled and this limit is higher the thicker the section. Sections 0.2 in. and thicker, show losses so small as to be unimportant structurally even after extended exposure to very severely corrosive conditions. No appreciable losses in load supporting ability in beams and columns occurred under severely corrosive conditions which caused marked losses in mechanical properties of thin-sheet specimens of the same alloy. Ha+VVK (13)

Poisoning and Activation of Aluminum and Cadmium when Dissolving in Hydrochloric Acid (Vergiftung und Aktivierung des Aluminiums und Cadmiums beim Lösen in Salzsäure) K. Jablczynski & T. Pierzchalski. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 217, Apr. 7, 1934, pages 298-304. The dissolving velocity of Al and Cd in HCl with different additions (KCNS, HCNS, CS_2, H_2S, etc.) was investigated. From these and previously made experiments it was concluded that the dissolving process of metals in acids does not alone consist in the diffusion of the dissolved material to the solid phase or vice versa but must be connected with real chemical reactions going on on the metallic surface or in the solution. 8 references. Ha (13)

Corrosion Fundamentals. C. E. Beynon. *Journal Society Chemical Industry,* Vol. 52, Apr. 28, 1933, pages 359-363. General theoretical review. VVK (13)

Effect of Corrosive Agents on Admiralty Metal. Sidney Born & W. L. Nelson. *National Petroleum News,* Vol. 25, July 19, 1933, pages 27-31. Time-loss of weight curves are given for Admiralty metal tubes in solutions of different concentrations of HCl, H_2SO_4, H_2S, NaOH, NH_4OH, NaCl, $Na_2CO_3 + K_2Cr_2O_7$, CO_2, $NaHCO_3$, Na_2CO_3, and $Ca(OH)_2$. Admiralty metal is most actively attacked by NH_4OH and HCl, even low concentrations of which may destroy the tubes in a few months. H_2S (at very low concentrations), lime and dilute NaOH have little effect on Admiralty metal. Hard water has little effect unless the scale is allowed to accumulate. As far as the corrosion of Admiralty metal is concerned, NaOH appears to be the best neutralizing material for acid corrosion. 21 references. VVK (13)

Aluminium Drums for Chemicals. H. V. Churchill. *Chemical Industries,* Vol. 34, Mar. 1934, pages 215-216. Brief description of constructional features of some Al and Al-alloy drums to contain HNO_3 and H_2O_2. RAW (13)

Rubber Coatings for Abrasion and Corrosion Resistance. Leonard Church. *Chemical & Metallurgical Engineering,* Vol. 40, Sept. 1933, pages 467-469. A description of how surfaces of any shape, if zinc coated, are immersed in rubber latex which is deposited by ionic coagulating action. By varying composition of deposit, hard or soft rubber is obtained. Corrosion resistance to acids and salts at temperatures below 150-170°F. is obtained. The coatings are also wear-resistant and insulate against heat, sound and vibration. PRK (13)

Effect of Water and Steam on Boiler Steel (Einfluss von Wasser und Dampf auf Kesselwerkstoffe) N. Christmann. *Stahl und Eisen,* Vol. 53, Dec. 28, 1933, pages 1353-1357. Contains a résumé of the mechanism of scale formation in boilers. The solubility of $CaSO_4$ in water diminishes with rising temperature so that scale is more apt to form at more highly heated spots; excessive local overheating may then ensue and cause a failure. H may form from the dissociation of steam in contact with the boiler walls; this H may reduce the $CaSO_4$ scale, evolving H_2S which is corrosive. Corrosion-fatigue may then occur at the more highly stressed points. Good boiler water treatment will avoid such damage, most important being the maintenance of a definite Na_2CO_3-Na_2SO_4 ratio, a uniform water flow, and the use of a steel more resistant to corrosion-fatigue. SE (13)

Corrosion of Condenser Tubes. (Anfressungen an Kondensatorrohren) N. Christmann. *Maschinenschaden,* Vol. 10, 1933, pages 23-26. See *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 164. EF (13)

Preventing Corrosion in Ice Plants (Wege zur Verhütung der Korrosion in Eiserzeugern) A. Freundlich. *Zeitschrift für die gesamte Kälteindustrie,* Vol. 40, Sept. 1933, pages 147-148; Dec. 1933, pages 191-192. Pb coatings are given preference to Zn coatings for parts which are in touch with the brine solution, but an additional Zn layer is deposited on the Pb coating at the top of the ice mold. The Fe can must be of uniform material. No reinforcement should be welded or riveted onto the mold. Welding rods must consist of the same material as the welded parts which are in contact with the salt solution. A low air or rather O_2 content is very essential to check the corrosion attack. Deaeration means are suggested to eliminate the air dragged along into the solution by the bottom of the cans. The hydrogen ion concentration of the brine should be 8-8.5. Due to diffusion of acideous air or of water from the thawing tank which contains acidifiers, the brine becomes corrosive. Na phosphates reinstate the correct pH value. Short circuits between the ice freezing tank and some worn out electric lead wires result in severe corrosion attacks. EF (13)

Formation of Spots on Preserving Cans (Fleckenbildung bei Konservenbüchsen) Freitag. *Oberflächentechnik,* Vol. 11, Mar. 6, 1934, page 53. Yellow-brown spots which are often found on the inner walls of tin-cans of preserved foods are caused by organic S compounds contained in the preserve, as albumen, cystine, allylsulfide, etc.; they are not injurious to the food. A thin layer of tin-sulphide is formed which sometimes also attacks the Fe under the Sn. The use of a lacquer containing the sulphide for coating the interior wall is recommended instead of the ordinary copal lacquer; the sulphide lacquer remained stable also in the sterilization process. Ha (13)

Report of Subcommittee V on Total Immersion Tests (Report of Committee A-5 on Corrosion of Iron and Steel) F. B. Olcott, Chairman. *Proceedings American Society Testing Materials,* Vol. 33, Pt. I, 1933, pages 144-146. Progress report on sea water immersion test and riveted plate test. The test on No. 22 gage sheets exposed March 1, 1927, in sea water at the U. S. Naval Station, Key West, Fla., was completed Aug. 12, 1932, all sheets having failed. The group averages are:

No. of Sheets	Material	Life in Days
18	Non-copper Bessemer steel	733.1
18	Copper Bessemer steel	878.4
21	Non-copper open hearth steel	939.3
39	Copper open hearth steel	1082.0
18	Non-copper pure iron	1250.5
18	Copper pure iron	1419.5
6	Copper acid open hearth steel	782.0
6	Copper wrought iron	937.3
6	Non-copper wrought iron	605.1

No conclusions are to be drawn until the end of the test. VVK (13)

Corrosion of Metals by Phenols. F. H. Rhodes, P. A. Riedel & V. K. Hendricks. *Industrial & Engineering Chemistry,* Vol. 26, May 1934, pages 533-534. This investigation shows that Ni or the Cr-Ni steels of the 18-8 type should be satisfactory for use in handling and condensing the vapors of phenol or the cresols. Lead is rapidly attacked by tar acids and should not be used in handling these materials. The use of Cu in phenol stills and for containers for phenols at ordinary temperatures should be avoided, both because the Cu itself is attacked to a considerable extent and also because the products of the action of the tar acids on Cu cause discoloration of the phenol or cresol. MEH (13)

The Electrode Potential of Iron. III. Corrosion of Iron in Water in the Absence of Oxygen and Determination of the Solubility Product of Ferrous Hydroxide. K. Murata. *Journal Society of Chemical Industry, Japan,* Vol. 35, Nov. 1932, pages 523B-533B. Average variations of the solubility and solubility products of $Fe(OH)_2$ determined by three different methods are summarized. In the calculation of the solubility from the conductivity data and the pH values, and of the solubility products from the solubility data, complete ionization was assumed. Variations of the constants derived from the solubility agree well with those obtained from the conductance or from the pH values. This agreement is substantial evidence of the correctness of the assumption of complete ionization in the saturated solution of $Fe(OH)_2$. MAB (13)

Theory of Passivity Phenomena. Communication XIX. On the Breaking-Up of the Natural Oxide Layer of Iron During Rusting (Zur Theorie der Passivitätserscheinungen. XIX. Über den Abbau der natürlichen Oxydschicht des Eisens beim Rostvorgang) W. J. Müller & W. Machu. *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 166, Oct. 1933, pages 357-364. The experimenters developed a method suited for the geometric measurement of the electrode area covered by an oxide film and of the metallic surface deprived of the latter. The experimental results proved to be in agreement with previously employed indirect testing methods based on the evaluation of the $i_o t_p$ curve. (See *Metals & Alloys,* Vol. 4, July 1933, page MA 209.) The Fe samples were artificially rusted in a 1/10 N Na_2SO_4 solution. Results are presented graphically. The fundamental law underlying the disintegration of the oxide film was found to be an exponential function. As a characteristic value, the half-life times of the disintegrating oxide film are derived for various electrodes employed. EF (13)

What is Rail Batter? J. A. Peabody. *Railway Engineering & Maintenance,* Sept. 1933, pages 421-424. Paper before the Maintenance of Way Club, Chicago. Speaker found that shimming up has produced the same results as welding, that is, rail ends having an apparent batter have such batter reduced to practically nothing. What remains cannot be taken out with shims, it must be taken out by means of heating or welding, the same as is done after building up angle bars have been applied. The batter of rails should be divided into 2 parts: "droop" and "batter." Studies finally determined that this droop was caused by the wear on top of the angle bars and on the underside of the rail head. When the angle bar is bowed in as the bolts are tightened, the rail is bent downwards and no amount of tamping will keep the joint up for any length of time. WH (13)

Corrosion Protection by Coatings with Particular Reference to the Viscose Silk and Film Industry (Beitrag zur Korrosionsverhütung durch Schutzanstriche unter besonderer Berücksichtigung der Viskosekunstseide- und Visckosefilmindustrie) Fritz Ohl. *Die Metallbörse,* Vol. 23, Nov. 1, 1933, pages 1390-1391; Nov. 8, 1933, pages 1422-1423. The wear of material in the viscose film and silk industry is particularly severe due to the presence of acid and alkaline (partly hot) reagents, and aggressive H_2S, Cl and HCl vapors. Bituminous coatings applied in 2 layers (30 kg./m.^{2} protected area) stand up for 2-3 years. However the maintenance costs (20) are rather high as compared with the coating expenses (5) and initial costs of the material itself (3-3.5). The corresponding figures for red lead coatings are 20:7.5:2.8-3 and for the strongly recommended anti-rust agent "Nust" 20:2.5:3.4. The latter represents a colloidal dispersion of Pb in linseed oil varnish. Physical and corrosion tests with "Harvelsupra" and "Duprenol" (corrosion solutions listed) yielded good results, while red lead-iron mica coatings widely utilized in this industrial field, failed. The latest non-metallic coatings even surpassed bituminous coatings successfully employed at present. EF (13)

Causes of Boiler Failures. J. Neill Greenwood. *Commonwealth Engineer,* Vol. 21, Feb. 1, 1934, pages 189-194. Discusses the chemical reactions and physical phenomena underlying the cracking of boiler plates and rivets in service. The definite characteristics of the following 3 main types of crack are considered and shown in 8 illustrations. (1) Corrosion cracks due to the action of local stresses introduced in manufacture together with corrosive conditions. (2) Corrosion fatigue cracks due to high fluctuating stresses together with corrosive conditions. (3) Intercrystalline cracking due to high steady stresses together with the influence of a specific corroding agent which destroys the bond between the crystals. Particular attention is devoted to intercrystalline cracking, its causes and prevention. WH (13)

White-Metal Bearing Alloys: Mechanical Properties at Different Temperatures and Service Tests. Harry K. Herschman & John L. Basil. *Bureau of Standards Journal of Research,* Vol. 10, Jan. 1933, pages 1-5. A study was made of the wear resistance and other properties of 11 white-metal bearing alloys. These include 2 Sn-base and 8 Pb-base alloys and 1 Cd-base alloy. Each of the properties, with the exception of wear resistance was determined at several temperatures, ranging from 20°-200°C. Resistance to wear was determined only at 20°C. No one of the alloys tested was found to excel in all of the mechanical properties studied. Thus, the Sn-base alloys showed higher resistance to wear and in most cases had higher Izod impact values, at each temperature of test, than the Pb-base alloys, but in most cases, showed lower resistance to pounding than the Pb-base and Sn-Zn alloys. The hardness numbers and compressive properties of the Sn-base alloys were found to be lower than those for the alkaline-metal hardened Pb alloys and a Cd-Zn alloy. The mechanical properties of the Pb-Sb-Sn alloys were, in most cases, higher as the Sn content was increased. Crank-shaft bearings of 4 compositions were prepared for service tests in United States Army class B trucks. These compositions consisted of 2 Sn-base and 2 Pb-base alloys. Results of these tests indicate that the Sn-base alloys were superior in their wear resistance to the Pb-base alloys. These results were consistent with those obtained in the laboratory tests. See also *Metals & Alloys,* Vol. 4, Sept. 1933, page MA 276. WAT (13)

Notes on Piston Rings and Their Relation to Liner Wear. *Steam Engineer,* Vol. 3, Mar. 1934, pages 261-262. Extract from paper read before Inst. of Marine Engineers. Problems associated with the manufacture and use of piston rings are surveyed. AHE (13)

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Progress Report Upon the Cause and Extent of Pitting and Corrosion of Locomotive Boiler Tubes and Sheets, Giving Consideration to Quality of Water, Character of Metals, Method of Manufacture and Types of Boiler Construction. *Proceedings American Railway Engineering Association,* Vol. 33, 1932, pages 268-270. The results of 5 yrs. service tests are summarized. Close control is necessary in adding caustic alkali—the commonest method of combating pitting. The counter-electric potential method and the use of arsenic compounds have received several favorable reports. Special non-corrosive constructional materials are too expensive to justify their use. JCC (13)

Corrosion-Accelerated Wear. Horace J. Young. *Automobile Engineer,* Vol. 23, Aug. 1933, pages 295-297. Discusses the effect of corrosion due to lubricating oils on crankshaft bearings. Chiefly concerned with the properties of the lubricants, but photomicrographs show the effect of corrosion. Composition of the materials corroded is not given. RHP (13)

Piston Rings and their Relation to Liner Wear. *Metallurgia,* Vol. 9, Dec. 1933, pages 46-48. Review of paper by H. J. Young given before the Institute of Marine Engineers on Dec. 12, 1933. Wear resistance of different cast irons is discussed. JLG (13)

Remarks on the Study of the Corrosion of Metals and the Corrosion of Various Alloys of Magnesium (Remarques sur l' étude de la corrosion des métaux et la corrosion des divers alliages de magnésium) A. Portevin, P. Bastien & M. Bonnot. *Comptes Rendus,* Vol. 196, June 26, 1933, pages 1999-2002. In a study of corrosion of the Mg-Al-Cu and Mg-Cu-Si alloys in various reducing acids and salts, an attempt was made to obtain a constant rate of corrosion by using a cylindrical test piece in a coaxial current of liquid. It was found that the corrosion curve (corrosion being defined by the evolution of gas accompanying it) became rectilinear and of constant inclination when the speed of the corroding medium exceeded 4.6 m./min. The slope of the straight line representing the constant speed of corrosion for rates of circulation equal to, or exceeding, this limit has been referred to as the coefficient of corrosion. By this means it has been possible (1) to characterize each alloy by a single corrosion coefficient, and (2) to make evident the phenomena complicating that of simple corrosion—in particular, any such as are associated with modifications of the state of the surface of the sample being tested, in which case the curve ceases to be linear. Using the above methods, the authors have been able to show that the speed of corrosion in dilute sulphuric acid of the ternary alloys Mg-Al-Cu, rich in Mg, can be represented by a surface showing a valley of which the trough in projection corresponds to the limits of the ternary solid solution rich in Mg. Provided the alloys show no second constituent, the addition of Al diminishes corrosion. The results are identical in solutions of N/2 $MgCl_2$; on the contrary, in dilute citric acid the speed of corrosion decreases continually in proportion to the Al content, indicating the formation of a superficial protective coat. In the Mg-Si alloys, the initial speed of corrosion in dilute HCl increases with the Si content, but the corrosion curve is not rectilinear, which apparently indicates that the compound Mg_2Si present in the alloy leads to its auto-protection. The presence of Si leads to an acceleration of the corrosion of Mg, which, however, is complicated as a result of the protective influence of Mg_2Si. The addition of Al to these alloys at first reduces the corrosion but later increases it. Si at first accelerates it but later reduces it. This example furnishes a good illustration of two laws governing the corrosion of alloys, which the authors refer to as the law of homogeneity and the law of auto-protection. OWE (13)

Silicon Bearing Cast Iron Resistant to Acids and Alkalies (Säure- und alkalibeständiger Siliziumeisen-Guss) F. Kundt. *Die Metallbörse,* Vol. 23, Aug. 5, 1933, page 989. The following properties are claimed:

	m.p. °C.	spec. weight	B.H.	electr. cond.	deflection at 600 mm. suspension, 30 mm. rod
Si bearing cast Fe	1220	6.9	290-350	1.05	2.0-3.0
Ordinary cast Fe	1150	7.25	150-250	1.3-2.0	10-12

A passivation often stops further reduction in wall thickness and discoloration of solutions. The thermal conductivity is about half that of ordinary cast Fe. Impacts and uneven heating must be avoided. A cast steel shell is often employed and the gap is filled out with Pb. Data on resistance against H_2SO_4, phosphoric acid solutions, Fe chloride, Na sulfide, stannous chloride, Cl gas, etc. and utilization in chemical industry are considered. EF (13)

Recent Developments in Corrosion Resisting Steels. J. H. G. Monypenny. *Proceedings Staffordshire Iron & Steel Institute,* Vol. 47, Session 1931-32, pages 39-51. Stainless steels of today have been developed from two types of materials, the 12-14% Cr and the austenitic Cr-Ni steels. Steels containing 12-14% Cr are air hardening steels and their properties are influenced by carbon content. Steels containing 16-20% Cr possess decidedly greater power of resistance to various forms of corrosion than the 12-14% Cr steels. Experiments indicated that hardening capacity could be restored to the high Cr steels, without any detrimental effect on their corrosion resistance, if a small amount of Ni were added. Intergranular attack of austenite steels (8% Ni, 16-20% Cr) is due to the precipitation of an intergranular membrane of carbide formed when the steel is heated to between 500 and 900°C., but more rapidly in the range 600-700°C. The carbon which the austenite of these steels (0.10-0.15% C) can dissolve even at high temperatures is much less than that which pure gamma iron can take into solution, the amount diminishing very rapidly as the temperature falls. Tungsten considerably retards the precipitation of the carbide. 3-4% Mo added to the steels greatly improved the resistance towards dilute H_2SO_4 at high pressure and temperature. The addition of about 2% Cu to the Cr-Ni steel also increases the resistance to H_2SO_4 but not to the same extent as the Mo. Tungsten increases strength at high temperature. Raising the Si content of the steel also increases acid resistance. A high content of Si gives very marked protection against scaling at high temperatures. GTM (13)

The Influence of Solution Concentration on the Severity of Corrosion Fatigue. A. J. Gould. *Engineering,* Vol. 136, Oct. 27, 1933, pages 453-454. The steel used for these tests contained 0.15% C, 0.21% Si, 0.59% Mn, 0.015% S, 0.018% P and 0.18% Ni. Tests were made using distilled water, air, and KCl. Na_2CO_3 was used for the corrosion inhibitor tests. Corrosion inhibitors were found to inhibit corrosion-fatigue action according to concentration, weak solutions approximating the very severe effect of distilled water, and strong solutions improving the qualities of the metal. Concentrated saline solutions exerted an influence far more severe than distilled water alone. KCl solutions of concentrations from 2M to M/40 were found to give the same severity of effect. Below M/40 the severity approached that for distilled water with very weak solutions. Curves are given. LFM (13)

The Dependence of Corrosion Velocity of Copper Upon the Thermal and Mechanical Pretreatment of the Copper (Ueber die Abhängigkeit der Korrosionsgeschwindigkeit des Kupfers von der thermischen und mechanischen Vorbehandlung des Kupfers) DuBois. *Oberflächentechnik,* Vol. 10, Oct. 24, 1933, page 235. Preliminary results show that corrosion of Cu is influenced by the arrangement of the crystallites, but there exists a difference between refined and electrolytic Cu. and also between hard and soft electrolytic Cu. X-ray tests revealed that soft-annealed material has an orientated crystallite arrangement, hard material an unorientated. Electrolytic Cu showed a lower resistance against H_2SO_4 than refined Cu. Rolling produces differences in the crystallite arrangement and therefore different corrosion resistance. It is proposed to use as definition of the intensity of an attack by acid on a material not the percent loss in weight but the time required for corroding away 1 mm. thickness from the surface of the material by the corroding agent, and also to state previous thermal and mechanical treatment of the material. Ha (13)

Testing for Corrosion Stability and Intercrystalline Corrosion (Prüfung auf Korrosionsbeständigkeit und interkristalline Korrosion) *Die Naturwissenschaften,* Vol. 21, Dec. 15, 1933, pages 887-888. Carbide precipitation is made visible by using a drop of HNO_3 (1:10) for 2 min. or by drying up a drop of 50% acetic acid 5 to 10 times. Rusting indicates too low a Cr content or faulty heat treatment. Welding involving temperatures of 500°-900°C. causes carbide precipitation and subsequent intercrystalline corrosion. Electric welding is less harmful than autogeneous welding due to shorter welding times. New brands of austenitic steels are on the market which are immune towards intercrystalline corrosion so that these steels are now widely used in the chemical industry, breweries and dairies. EF (13)

Corrosion Fatigue of Nickel-coated Mild Steel. *Machinery,* London, Vol. 43, Nov. 2, 1933, page 144. Discussion of tests carried out at the National Physical Laboratory. From 18 machined specimens 9 were subjected to the Fescolizing process (Ni deposition). The results of the corrosion fatigue tests are presented in a table. The estimated endurance limits for 20 million cycles under the corrosion-fatigue conditions employed in the tests are: untreated mild steel about ± 7.3 tons/in.^{2}, fescolized mild steel ± 12.2 tons/in.^{2} Kz (13)

Corrosion From Products of Combustion. 33rd Report of the Joint Research Committee of the Institute of Gas Engineers. *Gas Journal,* Vol. 204, Nov. 1, 1933, pages 2-4 supplement; Nov. 15, 1933, pages 502-505. Effect of sulphur and the resistance of various metals is discussed. The amount of sulphur present in combustion products, the amount of condensation in flues, the merits of hot-galvanized Fe, laboratory tests for corrosion, new apparatus to estimate the SO_2 content, the ammonia content of gas, and the formation of gum were the special topics mentioned. MAB (13)

The Green Patina on Copper. Artificial Production for Architectural Use. *Chemical Trade Journal & Chemical Engineer,* Vol. 93, Oct. 20, 1933, page 283.
Künstliche Patina. *Farbenzeitung,* Vol. 38, Dec. 16, 1933, page 1737.
Patina consists essentially of basic Cu sulphate and not Cu carbonate. The material formed first is the normal Cu sulphate which changes into basic Cu sulphate, or brochantite, after exposure for about 70 years. Brochantite appears to remain constant up to 300 years. Artificial production of patina is obtained by immersing the metal in a sulphate electrolyte containing an oxidizing agent. After 15 min. a green patina is produced which is insoluble in water. After removing from the bath, this deposit is changed on exposure to the air to brochantite. The process can also be applied to bronzes. Copper containing 0.5% As yielded the best results. The presence of As secures a better bond between the deposit and the metal. Arsenical Cu is also more resistant to atmospheric corrosion. EF (13)

Greater Purity Gives Iron New Uses. *Chemical & Metallurgical Engineering,* Vol. 40, Aug. 1933, page 413. Uses of Svea Metal, analyzing 99.92% iron, are mentioned. They are principally a source of iron for chemical manufacturing plants, for pharmaceutical and textile and pigment industries, and also as a material of construction. PRK (13)

Corrosion in the Upper Boiler. Practical Experience (Korrosion im Oberkessel. Betriebserfahrung) *Brennstoff & Wärmewirtschaft,* Vol. 15, Nov. 1933, pages 182-183. Investigation into severe corrosion attack in the upper boilers of a multiple boiler plant revealed insufficient degasification of the boiler water and free access of atmospheric O_2 to the boiler water tank. EF (13)

Present Status of the Question of Protection of Metals against Corrosion. Recent Developments (État actuel de la Question de la Protection des Métaux contre la Corrosion. Ses Developpements les plus récents) P. E. Kelecom. *Revue Universelle des Mines* ser. 8, Vol. 10, Mar. 1, 1934, pages 130-133; Mar. 15, 1934, pages 158-163. Present means of preserving metallic surfaces from attack and corrosion are reviewed under 3 heads: Protective methods by coating with another material, as tar, asphalt, enamel, drying oils, varnishes. Protective methods by modification of the composition of the metal, either by alloying, or only by changing the surface, as sherardizing, nitriding, parkerizing, coloring, etc. Protection by covering by another metal, as mechanical plating, electroplating, or by dipping in hot metal (galvanizing). Procedures in these different methods and apparatus and equipment used are described. Ha (13)

Application of Recent Research on Physical Properties to Practice (Die Auswirkung der neueren Festigkeitsforschung in der Praxis) E. Lehr. *Zeitschrift Verein deutscher Ingenieure,* Vol. 78, Mar. 31, 1934, pages 395-396. Results of observations and investigations of tensile properties of connecting rods of double-acting Diesel engines are reported. These were made to explain unexpected fractures in very carefully selected alloy steels; in most cases lack of endurance strength caused by the cooling water was responsible. Corrosion was considerably stronger for low water velocities, also temperature rise increases corrosion considerably. The cold cooling water should enter the bore of the connecting rod and the warm water flow back through a separately inserted pipe of corrosion-proof material. A little lubricating oil added to the cooling water reduced corrosive action largely, soft water exerted a stronger corrosive action than hard water (with NaCl content). Ha (13)

The Effect of Hydrogen Sulphide on the Corrosion of Iron by Salt Solutions. S. C. Britton, T. P. Hoar & U. R. Evans. *Journal Iron & Steel Institute,* Vol. 126, 1932, pages 365-373; *Iron & Coal Trades Review,* Vol. 125, Sept. 16, 1932, pages 412-413 (condensed). See *Metals & Alloys,* Vol. 4, May 1933, page MA 138. Ha (13)

The Rapid Development of Patina on Copper. John R. Freeman, Jr. & P. H. Kirby. *American Metal Market,* Vol. 39, Sept. 14, 1932, page 2; *Metal Industry,* N. Y., Vol. 30, Oct. 1932, page 404. See *Metals & Alloys,* Vol. 4, Nov. 1933, page MA 345. DTR + PRK (13)

Reducing Metal Corrosion Rate by Use of an Inhibitor. A. R. Dunham. *Gas Age Record,* Vol. 71, June 24, 1933, pages 657-658. The inhibitor used was tetralin (tetrahydronaphthalene). A mixture of air and products of combustion of a gas flame mixed with steam with and without inhibitor was conducted over metal specimens for 2 and 5 hr. periods. The inhibitor reduced the rate of corrosion to from 1/2 to 1/10 the rate without inhibitor. Short exposures gave higher rates than long exposures due to protective film formation. Without inhibitor copper-bearing steel was much superior to iron or steel, giving 2 to 3 times the usual life. VVK (13)

Corrosion Properties of Bronzes (Ueber die Korrosionsfestigkeit von Bronzen) O. Dahl. *Paper Third Corrosion Congress Verein deutscher Ingenieure, Verein deutscher Eisenhüttenleute, Deutsche Gesellschaft für Metallkunde and Verein deutscher Chemiker, Nov. 14, 1933. Berlin.* Mimeographed report, pages 2-3. Survey on the behavior and suitable application of Cu-Sn, Cu-Al, Cu-Si and Cu-Ni alloys. Bronzes are distinguished by high chemical stability in addition to good mechanical and technological properties. The good and poor properties of Cu determine the behavior of bronzes. The effect of the alloying constituents is not based on changes of potential but changes of the cover layers. On the basis of this discussion author endeavors to explain contradictions that result in part in determining numerically the effect of the individual elements or that exist between laboratory tests and practical observations. GN (13)

Value of Corrosion Tests of Metals (La Valeur des Essais de Corrosion des Métaux) A. Nogues & J. Cournot. *L'Usine,* Vol. 42, Sept. 7, 1933, pages 21-23. The present methods of testing a metal for its resistance to corrosion and to express its value are considered by both authors as of exaggerated importance often leading to erroneous judgments as regards quality; they require that tests prescribed in specifications permit an absolute result independent of the personal factor and be such that the material can be classed exactly. Several examples of misjudged quality are cited and methods for testing briefly reviewed. Ha (13)

Aluminum Equipment for Bleaching by Oxygenated Water (Le matériel en Aluminium dans le blanchiment à l'eau oxygénée) H. Tatu. *Revue de l'aluminium et de ses applications,* Vol. 10, May-June 1933, pages 2079-2087. By laboratory tests T. shows that Al has no catalytic action on the decomposition of oxygenated water and that it is entirely resistant to corrosion by solutions used for bleaching. Some suggestions are offered as to the use of aluminum for bleaching equipment. AH (13)

Note on the Green Patina on Copper: Examples from Elan Valley (Wales) and Dundalk (Ireland). W. H. J. Vernon. *Institute of Metals, Advance Copy* No. 649, Sept. 1933, 4 pages. The 2 samples were from sparsely populated territory well removed from industrial atmospheres. The copper from Elan was about 30 years old and the other about 150 years old. Both samples consisted mainly of basic copper sulphate. The one from Elan contained 20.75% basic copper chloride and the other 8.5%. The analysis of the older sample conformed more nearly to the composition of the mineral brochantite. JLG (13)

Steel in Sea Water Examined after 31 Years Exposure. J. S. Unger. *Engineering News-Record,* Vol. 111, Nov. 6, 1933, pages 593-594. Solid circular steel piling 6″ in diameter was inspected after 31 years' exposure in the waters of the Gulf of Mexico. Considerable incrustation of scale was found. Metal loss from corrosion varied from ½″ at the top to $\frac{1}{16}$″ four feet from the top. Localized pitting was at a minimum. CBJ (13)

Heat and Corrosion Resisting Cast Iron. J. Yamamoto & R. Yagi. *Suiyokwaishi,* Vol. 8, June 1933, pages 257-262. Corrodibility and heat-resisting properties of Nimol, Nicrosilal and similar cast irons were investigated. The cast iron containing C 2.2%, Si 6%, Ni 13%, Cr 1.5% and Cu 5-6% was found to be superior with respect to heat and corrosion resistance. HN (13)

Study of the Exothermic Phenomenon at the Surface of a Gray Cast Iron Piece in the Atmosphere after Corrosion by Sulphuric Acid. Yoichi Yamamoto. *Bulletin of the Institute of Physical and Chemical Research, Tokyo,* Vol. 11, Nov. 1932, pages 1215-1236. The exothermic phenomenon was noticed in H_2SO_4 as previously established in HNO_3 (See *Metals & Alloys,* Vol. 4. Sept. 1933. page MA 281 L10) and in HCl (See *Bulletin of the Institute of Physical & Chemical Research,* Tokyo, Vol. 11, July 1932, pages 834-859). The maximum temperature rise was found at the surface of a piece corroded with 6.0% H_2SO_4 solution. The amount of the temperature rise gradually decreased above this concentration. The exothermic phenomenon could not be recognized on a sample corroded in H_2SO_4 above a concentration of 40%. WH (13)

The Corrosion Problem. O. A. Knight. *Mineral Industries, Pennsylvania State College,* Vol. 3, Oct. 1933, pages 2, 4. General. AHE (13)

Deterioration and Protection of Lead Cable Sheath (La déterioration et la protection des gaines de plomb des câbles électriques) L. Lussaud & A. Noirclerc. *Revue Générale de l'Electricité,* Vol. 34, July 8, 1933, pages 19-29. Electric power and telephone cables with Pb covering are subject to mechanical deterioration, attack by intercrystalline corrosion and chemical corrosion. An alloy of Pb with 3% Sn is harder than pure Pb and gives sufficient mechanical protection. Intercrystalline embrittlement often follows such alternating stresses as occur when the cables are placed on bridges by the vibration and movements of the latter; alloys of Pb with Sn and Sb are more resistant than pure Pb and used in such cases. The many varied causes of chemical attack have been minimized by covering the sheath with a layer of mercury sulphide. Electrolytic attack of the sheath in the ground can be recognized by the salts formed on the surface of the cable, chlorides, sulphates, nitrates, according to the nature of the soil. Lead dioxide also forms under chemical attack. Means of protection against electrolytic deterioration are discussed in general. Ha (13)

Investigation of Corrosion of Tin-Silver Amalgams (Korrosionsuntersuchungen an Zinn-Silber-Amalgamen) N. Brecht-Bergen. *Zeitschrift für Elektrochemie,* Vol. 39, Dec. 1933, pages 927-935. The behavior of different Sn-Ag amalgams with respect to corrosion was investigated, the loss of weight being taken as measure. Corrosion of these amalgams is essentially not due to local elements but to the instability of the pure phases under the action of the corroding agents. The potential of all amalgams Sn-Hg-solid solution-Ag_3Sn is the same as Sn-Hg-solid solution which is the same as Sn. The corrosion was examined more closely in n/10 perchloric acid, n/10 citric acid, n/10 NaOH and n/10 NaCl solution. Anodic corrosion is more rapid than corrosion under natural conditions. 28 references. Ha (13)

Behavior of Steel Tubes under the Action of Attacking Substances (Ueber das Verhalten von Stahlrohren bei Einwirkung von aggressiven Stoffen) F. Eisenstecken. *Mitteilungen aus dem Forschungsinstitut der Vereinigte Stahlwerke A. G., Dortmund,* Vol. 3, Mar. 1933, pages 81-106. See *Metals & Alloys,* Vol. 4, Nov. 1933, page MA 344. Ha (13)

Aqua Regia and Base Metals—Rate of Corrosion of Iron and Nickel by Aqua Regia as a Function of Its Composition and Time of Mixture Charles F. Bonilla. *Industrial & Engineering Chemistry, Analytical Edition,* Vol. 4, Jan. 15, 1932, pages 128-130. The best conditions for the rapid solution in aqua regia of base metals have been determined. For each ratio and time of mixing before introduction of the metallic sample, the time of immersion and loss in weight are recorded, the rate of corrosion being calculated and plotted. Its greatest value is obtained at a definite acid ratio and time after mixing. For Ni, 3 volumes HCl to 40 of nitric, and for Fe, as low-C steel, 7:20 constituted the best mixtures with approximately 30 and 12 min. respectively for mixing. In both cases the maximum rate of corrosion obtained is about 16 times that obtained with a 4:1 mixture. MEH (13)

The Future of Light Metals (Die Zukunft der Leichtmetalle) W. Kollrepp. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Aug. 20, 1933, pages 348-349. Briefly considers the corrosion properties of light metals and alloys and methods of improving them. GN (13)

New Testing Method for Electrolytic Deposits and Its Application for Silver and Copper Plating (Ein neues Prüfverfahren für galvanische Niederschlage und seine Anwendung auf Versilberung und Verkupferung) K. W. Froehlich. *Mitteilungen des Forschungsinstituts und Probieramts für Edelmetalle,* Vol. 7, July 1933, pages 37-44. The new method is to test the resistance against wear (friction) of a deposited material and consists in letting sand of a certain grain size drop from a definite height and under a definite angle on to the deposit until the base metal appears; the amount of sand used serves as a measure for the wear resistance. This has proved more consistent and accurate than to measure the time. The method was used in investigating the influence of the composition of the electrolyte on the wear resistance; definite results were not obtained. Ha (13)

Sulphuric Acid Resistant Lead Alloys (Schwefelsäurebeständige Bleilegierungen) B. Garre & H. J. Mikulla. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 212, June 1933, pages 326-328. If Pb is alloyed with Ag-Cd in ratio 1:4, a considerably increased corrosion resistance against boiling concentrated H_2SO_4 is obtained. This is probably due to the Cd being dissolved out of the Ag and leaving the latter on the surface as a metallic layer. Pb-Ag-Cd alloys can be hardened by heat-treatment, quenching from 200° C. and aging. Ha (13)

Factors Governing the Life of Lead in Chemical Plants. R. S. Russell. *Chemical Engineering & Mining Review,* Vol. 25, Sept. 5, 1933, page 421. Physical properties and analysis of a good chemical Pb are given and the corrosion-resisting alloys of Pb briefly discussed. Pb-Cu and Pb-Te alloys are the most promising. Tests are being conducted, but results are insufficient for definite conclusions at this time. WHB (13)

APPLICATIONS OF METALS & ALLOYS (14)

Protection from Fire on Ships (La Protection contre l'Incendie à Bord des Navires) O. Quéant. *La Revue Industrielle,* Vol. 63, Aug. 1933, pages 397-403. It is shown that metals, which are incombustible, can be largely used in ship construction as well as in furniture making. A life-boat made of light alloy "Alpax" is illustrated. FR (14)

Gear Materials and Blanks. *American Standards Association. A.S.A.,* B 6.2-1933, July 1933, 10 pages. Gives American recommended practice for gear material and blanks of forged and rolled C steel, steel castings, bronze and brass castings, and forged and rolled alloy steel, sponsored by the American Gear Manufacturers Association and the American Society of Mechanical Engineers. AHE (14)

Warming of Water Pipes of Iron and Copper (Wärmeversuche mit Wasserleitungsrohren aus Eisen und Kupfer) St. Zeissl. *Zeitschrift für Metallkunde,* Vol. 25, Oct. 1933, pages 266-267. The objection raised against Cu water pipes that the running water would be too greatly warmed in passage to the faucet is shown by data to be without foundation. Two pipes, one of Fe galvanized inside and outside (27 x 19 mm.), and another of Cu (23 x 20 mm.), showed essentially the same capacity to heat contained water. Cold water (1°) put in pipes at 20° heated more rapidly in the Fe pipes owing to greater thickness of Fe pipes and greater heat capacity of Fe; when both pipes and water were initially at 1° and held in an atm. at 20° and 35°, respectively, the initial rate of warming was slightly greater with the Fe pipe, but the same for both after 30-60 min. RFM (14)

Report on New Specifications on the Application of Aluminum and Aluminum Alloys, Iron and Corrosion Resistant Steels to Containers of Tank Cars (Bericht über neue Bestimmungen für die Verwendung von Aluminium und Aluminiumlegierungen, Eisen und korrosionsbeständigen Stählen für Tankwagenbehälter) Hugo Schröder. *Der Apparatebau,* Vol. 46, Jan. 5, 1934, pages 1-2. A series of specifications on the application of the above mentioned metals and alloys for containers as required in Prussia. GN (14)

New Equipment May Stem Passenger Losses of Railroads. *Steel,* Vol. 92, Apr. 3, 1933, pages 13-14. Discusses trend toward lighter cars, utilizing stainless steel and Al in body construction. Former is used in the Budd-Michelin type and the latter in the "Autotram." MS (14)

Conflagrations on Board Ships (Les Incendies de Navires) *Revue de la Soudure Autogene,* Vol. 25, Jan. 1933, page 2686. It is explained that considerable progress would be made towards prevention against fire if all ships were equipped with metal furniture and decoration. FR (14)

Stout Railcar Weighs 25,000 Lbs. and Seats 50 Passengers. *Automotive Industries,* Vol. 69, Sept. 30, 1933, page 400. Body frame-work is of welded Cr-Mo steel tubing, without bolts or rivets. Covering is a dural skin. The first experimental tests on these lightweight railcars have been completed. They have 90 m. p. h. top speed, with 2 165 hp. engines driving axles of forward truck independently through automatic transmissions. DTR (14)

The Lancaster Piston. *Automobile Engineer,* Vol. 23, May 1933, pages 185-186. Deals primarily with the design of a piston having an Al head and a steel skirt. RHP (14)

Aircraft in 1933. The Motor Block (L'Aviation en 1933. Le Groupe Motopropulseur) Martinot-Lagarde. *La Technique Moderne,* Vol. 25, Apr. 1, 1933, pages 225-230; Apr. 15, 1933, pages 258-262. Description of motor blocks of the following manufacturers: Farman, Lorraine, Renault, Rolls Royce, Fiat, Salmson, Rhone, Hispano, Isotta-Fraschini, Gnome-Rhone, Clerget. For each type details are given concerning metals selected in various important parts of the motors. It is pointed out that very light alloys, of the Elektron type, which were previously used in covers and parts not subjected to fatigue are to be used in crankcases. Design of castings must take into account special properties of the alloys. FR (14)

XIIIth International Aircraft Show—Seaplanes (La XIIIème Exposition Internationale de l'Aviation—Les Hydravions) C. Martinot-Lagarde. *La Technique Moderne,* Vol. 25, Feb. 1, 1933, pages 94-98. In one section of the article dealing with materials used in seaplane construction it is explained that up to recent years the bodies of French seaplanes were made of wood which is not subject to corrosion but that now manufacturers are using duralumin and, preferably, the new alloy "Vedal" which is an Al clad duralumin; it is a well known fact that pure Al is much more corrosion resistant than duralumin. Stainless steel to be used in fittings. It is pointed out that engineers must use plates of adequate thickness and avoid contacts of 2 dissimilar metals. Several seaplane types are described. FR(14)

Effect of the Latest Knowledge in Material Research in Airplane Construction (Die Auswirkung neuerer Erkenntnisse der Werkstofforschung auf den Luftfahrzeugbau) Paul Brenner. *Zeitschrift für Flugtechnik und Motorluftschiffahrt,* Vol. 24, Sept. 28, 1933, pages 497-505. Paper read at the D. V. L. meeting, Berlin, Nov. 26, 1932. Deals with the influence of research on airplane construction, gains made by the application of light metal alloys, special steels, Pb bronzes etc. are pointed out. Discussing new or improved materials, light metal alloys are dealt with. "Silumin," an Al-Si alloy has been improved by additions of Cu (0.8%) and Mn (0.3%) and is called "Kupfersilumin." Further improvements were achieved by additions of Mg and the new alloy is designated as "Silumin-Gamma," containing: 12% Si, 0.5 % Mg, 0.3-0.5% Mn, remainder Al. Effects of heat treatment are discussed. Physical properties of different castings made from these alloys are tabulated. After dealing with improvements of Duralumin ("DM 31" and "Bondur") protective measures to prevent corrosion of Duralumin by sea water are discussed. A process of anodic oxidation of the surface to create a base for coatings—designated "Eloxal"—is touched upon. Materials (Alclad, Duralplat, Allautal, Albondur) to the surface of which a thin layer of pure Al or an Al alloy which does not contain Cu is welded, are discussed and the advantages of application are emphasized. Damaged parts are treated by spraying with pure Al. Discussing properties (tabulated) of Al-Mg alloys (Hydronalium, BS-Seewasser, Duranalium), containing 7-9% Mg and 0.5% Mn, the corrosion resistance of these alloys is illustrated by test results (tabulated). These alloys can be welded and used without protective coating, allowing for considerable savings in weight. Dealing with the application of steels, attention is called to V2a extra- and V4a extra-steels of Friedrich Krupp, Essen. These stainless steels contain Ti and can be welded without impairing the corrosion resistance. After dealing with non-metallic materials, testing of materials is discussed by means of test results. Examples illustrate the important influence of shaping and surface finish of materials on the strength of structures. In conclusion the application of X-ray tests is dealt with. Kz (14)

Forming and Fabrication of Metals in the Construction of Aircraft. Harold Crary. *Metal Stampings,* Vol. 6, Oct. 1933, pages 244-246. General description of equipment and processes employed in the forming and fabrication of Al and steel parts used in all-metal airplanes made by the Boeing Airplane Company, Seattle, Wash. All duralumin is heat treated in a molten salt bath at 950°F. for 12-22 min., quenched in cool H_2O, and rinsed in hot H_2O. Duralumin rivets are placed in dry-ice containers to retard their aging. All Al parts are given an anodic coating and all steel parts are Cd plated to protect them from corrosion. MS (14)

Die Casting, or Stamping? Herbert Chase. *Iron Age,* Vol. 132, Dec. 28, 1933, pages 26-28. Attempt to formulate hard and fast rules to govern selection of one or the other product is difficult and likely to involve numerous exceptions. Generally, if part required is flat and of uniform thickness so it can be turned out in simple blanking and piercing operation, stamping will serve the purpose. If piece is large and involves extensive surfaces in sections thinner than can be cast, stamping is a certain solution. Die casting is of advantage where several parts, each involving separate dies would be required as well as handling and assembly costs. Dimensions can be held within closer limits with die casting. Much depends on the complexity of the die. Further study of the subject is suggested. VSP (14)

Review of Customary Materials in Chemical Industries (Übersicht gebräuchlicher Werkstoffe für die chemischen Industrie) F. Cellin. *Die Metallbörse,* Vol. 23, Nov. 15, 1933, pages 1454-1455; Nov. 22, 1933, page 1487; Nov. 29, 1933, page 1523; Dec. 6, 1933, pages 1554-1555; Dec. 13, 1933, pages 1586-1587; Dec. 20, 1933, page 1619. The author lists in tabular form the metallic and non-metallic materials resisting some 41 inorganic, 34 organic acids, and 20 alkalines. Special columns refer to: (1) remarks on degree of corrosion resistance, (2) special service conditions in regard to temperature and pressure, (3) restricted use, (4) corrosion resistant metals and alloys entirely unsuitable for specific chemical reagent. EF (14)

New Principles of Construction (Neues Konstruieren) Deuring. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 23, Nov. 12, 1933, pages 632-634. Abstracts of papers by Modemann: "Wie gross ist die zulässige Spannung" and Rötscher: "Grundlagen der Berechnung von Maschinenteilen" before meeting of Arbeitsgemeinschaft deutscher Betriebsingenieure, Oct. 1933, Düsseldorf. Modemann surveys the status of our present knowledge on strength. He refers particularly to errors involved in former methods of calculating actual stress distributions in machinery parts that are chiefly due to the generally assumed uniform stress distribution. Rötscher's papers deal with the experimental methods of determining stress distribution, their results and with the practical methods of calculating stress distributions. GN (14)

Non-Ferrous (14a)

G. L. CRAIG, SECTION EDITOR

Palladium as a Substitute for Gold in Dental Procedures. E. M. Wise. *Dental Cosmos,* Vol. 75, Dec. 1933, pages 1230-1232. Pd has been in use in dentistry 30 to 40 years, but only in the past few years has the supply been adequate and its price low enough to make its extensive use practical. The increased price of gold makes Pd cost only about 2/3 as much, and it weighs only about 2/3 as much per unit volume; thus the cost per unit volume is less than ½ that of gold, and it is 50% stronger, and white in color. Pd melts at 1554° C., raises the m.p. of gold alloys, and strengthens them. Pd is attacked by HNO_3, which should not be used for pickling, but is insoluble in oral fluids. The alloys of Pd which are used in dentistry include: Pd-Ag, Pd-Au, Pd-Ag-Cu, Pd-Pt-Au-Cu-Ag, and Pd-Pt-Au-Ag-Cu-Zn, etc. One hard white casting alloy contains about 25% each Pd and Au with the remainder principally Ag and Cu. Partial replacement of Au by Pd reduces metal cost, raises the m.p., and generally increases the strength. Many Pd alloys are strengthened by heat treatment. OEH (14a)

Tests on White Metals for Socketing Winding Ropes. John Wilson. *Iron & Coal Trades Review,* Vol. 127, July 7, 1933, pages 1-2. Experiments were made to ascertain the best pouring temperature for white metals used in capping (fastening to the drum) of winding ropes. Incidentally the results revealed also important points on composition and the effect of heating on the strength of steel wire. A number of compositions are given. The melting point must be below 750° F. Although heating of the wire-rope to about 830° F. before using is often recommended, it seems unwise to raise the temperature to that degree. Up to 750° F. no diminution of strength was observed, and most of the white metals used have a melting point of between 350-400° F. It is of great importance that the white metal adhere very firmly to the wire. Tests by determining the pull necessary to draw the wire from the socket showed that cleaning the wires with petrol and then with emery cloth gave best results for adhesion. Ha (14a)

Certain Physical and Chemical Properties of Gold and Its Alloys. Mearle W. Wilkinson. *British Journal of Dental Science and Prosthetics—Prosthetic Section,* Vol. 78, October 1933, pages 279-287, correspondence, pages 331-332, 360-362; Vol. 79, Jan. 1934, pages 30-31. Reprinted from *Pacific Dental Gazette.* A superficial review of the dental metallurgy of gold and its alloys. JCC (14a)

Water Sterilization by Silver (Sterilisation von Badewasser mittels Katadyn) Viesohn. *Gesundheitsingenieur,* Vol. 56, July 8, 1933, pages 316-319. Reports on extensive investigations on Ag as H_2O sterilization means according to the "Katadyn" method of Dr. G. A. Krause, Munich. WH (14a)

Fire Ladders of Aluminum (Feuerwehrleitern aus Aluminium) P. Urech. *Aluminium,* Vol. 15, Dec. 15, 1933, pages 5-6. Ladders up to 49 m. (160 ft.) have already been built successfully; saving in weight against steel or steel-wood construction 35-50%. The Al alloy used in the construction has a tensile strength of 40-45 kg./mm.^{2}. Ha (14a)

Thermal Insulation with Aluminum Foil. J. F. O. Stratton. *Paper Trade Journal,* Vol. 98, Mar. 1, 1934, pages 37-39. Thermal insulation with a metal is obtained by taking advantage of the low thermal emissivity of aluminum foil and the low conductivity of air. Aluminum foil when applied is usually crumpled so that three layers take up an inch thickness of space. CBJ (14a)

Aluminum Foil and Its Uses (Die Aluminiumfolie und ihre Verwendung) E. Zurbruegg. *Aluminium,* Vol. 15, Dec. 15, 1933, pages 3-5. Al foil is now made mostly by strip-rolling whereby the Al is rolled from 40-60 kg. ingots to a ribbon of several miles in length under simultaneous tension and pressure at about 500° C. Besides replacing tinfoil, it finds wide application as heat and cold insulating material because of its excellent reflective power for heat rays; the insulating layer is composed of many layers of corrugated Al foil, the air spaces between the layers increase the heat insulating property. Advantages are high insulating capacity, light weight (1 m.^{3} corrugated Al foil weighs only 6½ lbs.), and it can be used up to 550° C., it is sanitary, insensitive to humidity, and free from bacteria. Ha (14a)

Alfol Heat Insulation (Der Alfol-Wärmeschutz) A. v. Zeerleder. *Schweizerische Bauzeitung,* Vol. 102, Jan. 27, 1934, pages 43-47. Alfol, the newest insulating material, is made of Al foils about .1-.005 mm. thick. Whereas, for instance, polished Cu reflects 96% of heat rays Al reflects 95%. However, due to atmospheric oxidation heat reflection of Cu decreases to 22%, while that of oxidized Al decreases only to 93%. Alfol insulation air layers are subdivided by the bright foil to decrease radiation losses. The foil is so dimensioned and arranged that the heat transmission at the contact point is reduced to a minimum. Cases of application are cited: insulation of refrigerator cars, insulation on steam turbines. GN (14a)

A New Technique for Constructing Fixed Bridge Work. E. A. Boreth. *Dental Cosmos,* Vol. 70, Nov. 1933, pages 1052-1056. Relates principally to casting gold alloys onto porcelain facings. The facing should be contoured so that it will not be crushed by the contraction of the gold in cooling. Author prefers centrifugal casting with the mold at a red heat. Slow cooling to minimize the difference in temperature between the porcelain and gold is recommended. The porcelain facings should be covered by investment in order to avoid excessive heating in soldering. OEH (14a)

Stelliting Valve Steels. F. R. Banks. *Mechanical World & Engineering Record,* Vol. 95, Jan. 26, 1934, pages 71-72. The treatment of valves and inserts consists of applying a layer of stellite to the seat surfaces, this being done by means of an oxy-acetylene torch. "Stelliting" is not a welding process but might be described as a high-temperature brazing process. The "stellite" welding rods for exhaust valves contain: 65% Co, 27% Cr, 4% W, 1.25% C, 2.7% Si, Rockwell hardness = 45, melting point 1276° C. This grade is more ductile and less liable to crack when used upon steel having high expansion characteristics. The composition of a harder grade is given as: 40-50% Co, 25-30% Cr, 15-20% W, 2.5-2.75% C, Rockwell hardness = 58. Troubles with this grade, caused by cracking, were attributed to the class of steel (Co-Cr), rather than to the brittleness of the stellite itself. The use of austenitic steels overcomes these troubles but these steels cannot be heat-treated after applying stellite. With martensitic steels it is possible to restore their structure by heat-treating. Method of application and type of flame used are discussed as well as bond and grain structure. Stelliting increases the cost of the finished valve by about 10%. Kz (14a)

The Catalytic Effect of Lead During Hydrogenation by Sodium Amalgams (Sur l'action favorisante du plomb dans les hydrogénations par l'amalgame de sodium) Gabriel Bertrand & S. Delauney-Auvray. *Bulletins de la société chimique de France,* Vol. 53/54, Oct. 1933, pages 1126-1129. Previous assumption that the presence of foreign metals inhibits the catalytic action of Na amalgams with reference to the hydrogenation process could not be confirmed. The authors found that amalgams containing 0.1-0.2% Pb can be pulverized just as easily as pure amalgams. At a concentration of 0.5% Pb, the amalgams however become too hard and furthermore decompose too slowly during the hydrogenation process. EF (14a)

Progress in Sintered Hard Metals (Fortschritte auf dem Gebiet der Sinterhartmetalle) Karl Becker. *Metallwirtschaft,* Vol. 13, Mar. 2, 1934, pages 159-160. Review of patents issued during the last four months on carbides, borides, silicides and nitrides of W, Mo, Co, Nb and N. CEM (14a)

Use of Aluminum Foil. *Journal of Commerce,* (*Shipbuilding and Engineering Edition*) Dec. 7, 1933, page 7. A system of metallic insulation for marine purposes, utilizing 0.007 mm. crumpled aluminum foil for heat and sound insulation for high temperatures as in turbines and for low temperatures as in refrigeration. JWD (14a)

Copper Heaters (Heizkörper aus Kupfer) *Gesundheitsingenieur,* Vol. 56, June 17, 1933, page 287. Critical discussion on Cu vs. Fe as structural material for heaters. The 7-8 times larger thermal conductivity of Cu is insignificant for heaters with smooth surfaces. The heat exchange does not only take place by direct transmission but also through radiation. The radiation power of Cu : cast Fe = 0.16 : 3.35. Cu is only adapted for ribbed radiators whose exterior heat exchange areas are 20-50 times larger than the interior heat absorbing areas. Longer ribs can be utilized with Cu radiators which properly designed require the following space Cu : cast Fe = 1 : 4.5, weigh only 1/5-1/6 of cast Fe heaters, are immune toward corrosion, require shorter heating times due to the lower spec. heat of Cu and to the reduced weight and space required and are easier to control. WH (14a)

Directions for Copper Roofing (Préscriptions pour des Traveaux de Couverture en Cuivre) *Cuivre et Laiton,* Vol. 6, July 15, 1933, pages 319-322. General technical instructions for using Cu as a covering material in architecture. Ha (14a)

Compo Bearings. *Automobile Engineer,* Vol. 23, Sept. 1933, page 347. Discusses an oil retaining P-bronze bearing being produced by Messrs. Hardy Spicer and Co., Ltd. Absorbs oil up to 40% of the volume of the material, requires no lubricator holes or oil grooves, and any increase in temperature brings oil to the surface on the bearing. Will withstand pressure of 75,000 lbs./in.^{2}. RHP (14a)

Application of Light Shapes in Agricultural Machinery Construction (Über die Verwendung von Leichtprofilen im Landmaschinenbau) G. Pollert. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 24, Jan. 28, 1934, page 43. Author describes successful application of light steel shapes to construction of potato grading machines. Such machines are considerably lighter than corresponding wooden structures. An essential advantage of light shapes is simple joining of parts. They are either welded or screwed together. Field will be promoted by use of rust resisting steels. GN (14a)

Light Metal Boats (Leichtmetallboote) A. Pyszka. *Schiffbau, Schiffahrt und Hafenbau,* Vol. 34, Nov. 21, 1933, pages 406-407. Drawings and photographs of a fast German police boat recently made entirely of light metal alloys. Due to the advance in corrosion resistant Al alloys, the hull was also made of light metals. WH (14a)

Wrought Clasps with Plastic Bases. M. E. Niswonger. *Journal American Dental Association,* Vol. 20, Nov. 1933, pages 2031-2038. Lists 7 requirements of wrought wire clasps in design and function. Metal clasps were used as early as the beginning of the 19th Century. Uses a 12%-Pt alloy of high proportional limit and tensile strength and considers such wrought gold wires superior to any cast clasp. In contouring the clasp the metal should be annealed after each bend is made, because bending cold works and hardens the wire. Annealing or softening is accomplished by heating to a dull red heat and plunging into cold water or acid pickle solution. (Abstractor's note: Many alloys used in dentistry are softened by quenching from a red heat but are hardened by slow cooling.) Reports that the elongation of these wires may be reduced as much as 88% by heat treating (slow cooling) and considers this the cause of much breakage. Anneals clasps before they are put into service as a means of avoiding breakage. OEH (14a)

Copper Pipes in Sanitary Plumbing (Le Tuyau de Cuivre en Plomberie sanitaire) Muzard. *Cuivre et Laiton,* Vol. 6, Dec. 15, 1933, pages 567-570. Economical and sanitary advantages of using Cu in plumbing materials are discussed. Ha (14a)

Aluminum. Electrical Uses of the Metal and Its Light Alloys. A. W. Muir. *Electrician,* Vol. 111, Nov. 24, 1933, pages 637-640. The high conductivity of Al and its light alloys and their non-magnetic characteristics contribute to their use in electrical service. Electrical applications fall into three groups: use as a conductor, for non-magnetic purposes, and for general mechanical properties. Examples of each type of service are discussed. CBJ (14a)

Metal Bearing with Permanent Lubrication (Metallager mit Schmierung auf Lebensdauer) Max Moldenhauer. *Die Umschau in Wissenschaft und Technik,* Vol. 37, Dec. 16, 1933, pages 1003-1005. Refers to porous metallic bearings which incorporate 30-40% by volume of oil. The bearings are made up with Cu and Sn (Zn) powder, compressed, brought to moderate temperature and dipped into the lubrication oil which fills the pores. Advantages claimed: Low oil consumption, nevertheless perfect lubrication, no metal losses during manufacture, less wear, no maintenance costs. Test results, microphotographs. WH (14a)

Light Metals Making Their First Conquest in Bridge Construction (Lettmetallene har gjort sin förste erobring paa brobygningens omraade) Reidar Lund. *Teknisk Ukeblad,* Vol. 81, Mar. 29, 1934, page 194. Describes the rebuilding of an old bridge in Pittsburgh where Al was used in place of steel with the result that the dead weight of the bridge was reduced by 750 tons. BHS (14a)

Seams for Fourdrinier Wires. II. Kurt Jahn. *Wire & Wire Products,* Vol. 9, Feb. 1934, pages 47-49. German methods of obtaining endless wire belts for Fourdrinier paper making machines are described. The welding operations for joining the wire cloth are illustrated and the procedure described in detail. Ha (14a)

Present Position of Airship Construction, Particularly of the Construction of Airship-frames (Der heutige Stand des Luftschiffbaues, insbesondere des Luftschiffgerippebaues) HANS EBNER. *Zeitschrift für Flugtechnik und Motorluftschiffahrt,* Vol. 24, June 6, 1933, pages 311-316; Vol. 24, June 28, 1933, pages 331-341. Comparative discussion of details in the construction of LZ 127, LZ 129, Akron, R 100 and R 101. Properties of the light metal alloys employed in the construction of these airships are discussed and tabulated. Attention is called to a new alloy DM 31 of the Dürener Metallwerken (yield point 40-42 kg./m.^{2}, tensile strength 50-52 kg./m.^{2}), which with better physical properties possesses the same degree of corrosion resistance. Although Duralumin has been mainly employed in the construction, except in the R 101 in which partly stainless steel has been used, the developments in welding will open a new field for steel in airship construction. Kz (14a)

Progress in the Industrial Application of Copper and Its Alloys. J. W. DONALDSON. *Metallurgia,* Vol. 9, Feb. 1934, pages 111-113. Mentions 0-free Cu and newly developed Cu alloys. JLG (14a)

The Future Trend in Forged and Cast Light Alloys. W. C. DEVEREUX. *Metallurgia,* Vol. 9, Feb. 1934, pages 101-102. An expanding demand for high-quality Al alloys is anticipated. JLG (14a)

Beryllium Copper Challenges Existing Materials. C. H. DAVIS. *Machine Design,* Vol. 5, Mar. 1933, pages 23-24. Springs for automatic telephones, motor brush holders and similar applications where electrical conductivity as well as high resistance to continuous alternate stress is a factor have been made of this material. The alloy in the form of diaphragms gives excellent service as borne out by laboratory fatigue tests. Annealed wires of the smaller sizes are woven into cloth and subsequently heat treated. Tensile strength of individual strands = 140-160,000 lbs./in.^{2}. Further applications discussed are gears, pinions, cams (weight reduction), valve guides (hard wearing surface), Bourdon tubes, bearings (low coeffcient of friction). Hard rolled sheets yield 165-210,000 lbs./in.^{2} tensile strength. Electric spot welding of Cu-Be has been accomplished on a commercial scale. Brazing, silver soldering and soft soldering are feasible. Cu-Be nickel plates easily. WH (14a)

Copper and Its Alloys in Watchmaking (Le Cuivre et ses Alliages dans les Traveaux d'Horlogerie) V. BRIARD. *Cuivre et Laiton,* Vol. 6, Dec. 30, 1933, pages 591-593. The importance of Cu and its alloys for the movement of watches and other parts is pointed out. Ha (14a)

Utilization of Light Metals in Shipbuilding (Über die Verwendbarkeit von Leichtmetallen im Schiffbau) OTTO SCHLICHTING. *Schiffbau, Schiffahrt und Hafenbau,* Vol. 34, Sept. 15, 1933, pages 317-319. The drawbacks of Al are its high price and lower rigidity due to the smaller mass required. The greater stability against tropical influences, fire and moisture proofness and favorable strength:spec. weight ratio permit Al alloys to compete with wood in shipbuilding. In most cases an increase of ship stability or reduction of deplacement is aimed at to employ larger ship engines, stronger armaments (warships) and higher speeds (speed-boats). Greater possibilities for sheet material than for cast and wrought parts are seen. Discusses the various German brands available from the following viewpoints (1) interior parts not exposed to any substantial stress. Hard rolled pure Al of 99.5% and Mn-bearing Al are chiefly utilized. The smoother surfaces of light metals as compared with steel and galvanized Fe are of great significance with respect to paint coatings and their maintenance. (2) Stressed members of upper-structure: bridge, fundaments, transverse bulk-heads, load carrying parts. Duralumin types are best suited. If corrosion occurs, plated material offers a remedy. (3) Hull, decks, longitudinal units. Hard rolled Al alloys with 5-10% Mg are utilized besides Duralumin. The former costs 1.5 times as much as the latter. Hydronalium can be hot riveted and welded. Cast alloys suited for shipbuilding are Silumin and KS Seewasser. A recent German invention, Alfol, (Al foil) as insulation material opens a new field. WH (14a)

Fifteen Years of Dental Research at the National Bureau of Standards. WILMER SOUDER. *Journal American Dental Association,* Vol. 21, Jan. 1934, pages 58-66. Reviews work which has been done at the Bureau of Standards in cooperation, first, with the Weinstein Research Laboratories, and since April, 1928, with the Research Commission of the American Dental Association. OEH (14a)

Condenser Tubes. *Tin,* July 1933, pages 15-18. While condenser tubes are now made of non-ferrous metals and alloys comparatively little Su is used in them. Recent investigations show that 70/30 brass tubes are satisfactory but liable to dezincification; addition of As to a 70/29/1 arsenical brass eliminated this trouble entirely. Another satisfactory alloy for condenser tubes used by the British Navy is a composition of 76% Cu, 22% Zn and 2% Al. Straight Sn-Cu alloys have not given satisfaction but a brass with 3-4% Sn has recently given consistently good results in marine work over several years. Ha (14a)

The White Alloys of Tin, The Type Metals and Solders. *Tin,* Jan. 1934, pages 6-9. After historical remarks as to their early history the properties of alloys used as type metal and in solders are discussed. The composition varies according to hand or machine setting; today 2-20% Sn, 12-18% Sb and the balance Pb is used. 3 grades of solders are distinguished: 1. best solder in which Sn predominates, 2. medium solder, consisting of equal parts of Sn and Pb, 3. common solder, with Pb predominant. Pure Sn makes a good solder. The melting point must be low enough to avoid injury to the metals to be joined, the solder must form an alloy with the metals, it must have adequate strength and reasonable corrosion resistance, and adequate fluidity at the soldering temperature. These points are discussed in detail. Ha (14a)

Markets for Tin. *Tin,* Jan. 1934, pages 4-5. Use of tin metal and tin sheets in refrigeration and air-conditioning is expanding. Ha (14a)

An Improved Method of Metal Coating Celluloid Foils for Offset Printing and Book Printing (Ein verbessertes Verfahren zum Metallisieren von Zelluloidfolien für Offsetdruck und Buchdruck) *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 24, Feb. 25, 1934, page 109. After discussing disadvantages of former methods applied in metal coating such foils, new process is described. GN (14a)

Miss America X To Have Monel Metal Propellers. *Steel,* Vol. 93, Aug. 28, 1933, page 38. Shafts are 1⅝ in. diameter and 10 ft. 4 in. long. Physical properties are: ultimate strength, 110,000 lbs./in.^{2}; yield-point, 100,000 lbs./in.^{2}; elongation in 2 in., 18%, and reduction of area, 60%. MS (14a)

Lubricant Contains Lead in Metallic Form. *Steel,* Vol. 93, Sept. 11, 1933, page 34. Note describing "Bestolife," a product of the Armite Laboratories, Los Angeles. It is used as a gear and bearing lubricant, packing, and belt dressing, and contains from 10 to 65% of finely divided Pb in a lubricant vehicle. Product is claimed to withstand temperatures up to 430° F. MS (14a)

Metallic Packings for High Pressures. *Railway Engineer,* Nov. 1933, pages 342-344. An investigation of the subject of fluid leakage which led to the introduction of a new type of rod packing for steam and Diesel engines. WH (14a)

Diesel Engines of 33½ lb. per B.H.P. *Motor Ship,* Vol. 14, Dec. 1933, page 318. The bottom half of the crankcase, the timing case, the reverse gear casing, the inlet manifold, the cam box, and all the covers of two 160 b.h.p. Gleniffer engines are manufactured of aluminium and show a 14% saving in weight. JWD (14a)

Silver and Its Uses in Chemical Plants. *Metal Industry,* London, Vol. 42, Mar. 31, 1933, pages 345-346. Physical and chemical properties of Ag are briefly described, its special value for chemical plant construction lies in freedom from oxidation, resistance to various commercial acids, high thermal and electrical conductivities and mechanical characteristics. It can now be rolled or drawn down to 0.0005″. Applications in acetic acid plants, in jewelry, surgical instruments are described. The relatively high cost of Ag is counterbalanced in many instances by the properties and the high scrap value of Ag. Ha (14a)

Stratosphere Craft Presents Materials Problem. *Machine Design,* Vol. 5, Aug. 1933, pages 27-28. The utilization of Dow metal for stratospheric crafts opens a new field due to the physical properties of this Mg alloy which is 1/3 lighter than Al and has a bursting pressure of 100 lbs./in.^{2} The gondola of stratosphere balloons consists of orange peel-like segments joined by welding. Seams are not peened and tensile strength of the welds proved to be 90% of the strength of the plates. Pb dust is used as ballast material. WH (14a)

XIIIth Aircraft Show (Le 13ème Salon de l'Aéronautique) PAUL MAZER. *La Revue Industrielle,* Vol. 63, Mar. 1933, pages 121-125. Construction of engines is discussed. Cylinder heads cast in Y alloy in permanent molds by 2 leading French firms are illustrated. FR (14a)

Contact Metals and Contact Care. P. MABB. *Metal Industry,* London, Vol. 43, July 7, 1933, pages 3-5. Materials for electrical contacts are discussed. Metals of the Pt group, also Ag and Au are too expensive for commercial purposes and alloys widely used are Pt-Ni or Pt-Co; W-Mo is particularly resistant to wear; binary alloys give usually less wear than the base metals of which they are composed. Of the ternary alloys only Au-Ag-Pt and Ag-Pd-Co are used. Instructions for mounting and maintaining contact points are given. Ha (14a)

The Part Played by Non-Ferrous Metals at Century of Progress Exposition. R. G. KING. *Metal Industry,* N. Y., Vol. 31, Dec. 1933, page 401. Exhibits of non-ferrous metal manufacturers are briefly discussed. PRK (14a)

Lead Bronzes in Automobile and Aircraft Motor Industry (Erwiderung auf "Bleibronzen in Automobil- und Flugzeugmotorenbau) MAX ARMBRUSTER. *Deutsche Motorzeitschrift,* Vol. 10, Aug. 1933, pages 156-160. Discussion of a previous article of E. Semmler (*Deutsche Motorzeitschrift,* Vol. 10, June 1933, pages 120-126). Writer denies that crank-shaft bearings offer any difficulties which are admitted in case of highly stressed connecting rod bearings so that white metal bearings still offer the best material available. According to the writer's investigations, failures of connecting rod bearings are due to minute cracks starting at the bearing surface but not due to inadequate joints between bearing and bearing shell as advocated by Semmler. Before the cracks show up a gain in hardness was noticed. The cracking and breaking out of pieces is ascribed to fatigue. Microscopic evidence is furnished showing that the joining of the bearing and bearing back does not represent a simple soldering process. EF (14a)

Specifications and Characteristics of Dental Materials. GEORGE C. PAFFENBARGER & W. T. SWEENEY. *Journal American Dental Association,* Vol. 21, Apr. 1934, pages 658-664. Trade names and manufacturers of dental materials which have been certified to the Research Commission *by the manufacturer* are given. The metals include amalgam alloys, inlay casting golds, dental mercury, and wrought gold wire alloys. A revised specification for amalgam alloy is given. The composition requirements for the amalgam alloy are: Ag 65% min., Cu 6% max., Zn 2% max., and Sn 25% min. OEH (14a)

Rare Earths and Their Utilization (Seltne Erden und Ihre Anwendung) KARL QUASEBART. *Die Umschau in Wissenschaft & Technik,* Vol. 38, Mar. 25, 1934, pages 244-246. Deals with the chemical treatment of monazit sand. Particular attention is paid to the use of cerium which is prepared by electrolysis of Ce chloride. Pyrophoric metal, an alloy of Ce with Fe is a widely used material. Ce improves the quality of Mg flashlight and it is utilized in glass industry in addition to neodymium. Neodymium and praseodymium yielded valuable artificial precious stones. Thorium is utilized as an alloy element in metallurgy, as a catalyst in chemical fields and for medical purposes, as a substitute for $BaSO_4$ in X-ray diagnosis. Thorium oxide is utilized as refractory material. Its melting point is 3000°C. WH (14a)

Developments in the Light Weight Constructions of the Rolling Stock of the German State Railroad (Fortschritte in der Anwendung des Leichtbaues auf die Personenwagen, Verbrennungstriebwagen und Beiwagen der Deutschen Reichsbahn) K. OTTO. *Organ für die Fortschritte des Eisenbahnwesens,* Vol. 89, Jan. 10, 1934, pages 31-34. Traces recent advances in light weight construction accomplished by improvements of design, utilization of high-grade structural steels and adoption of arc welding in place of riveting. Due to the latter change weight savings of 31% are arrived at on passenger cars. Due to their higher initial costs, light metals were not employed in place of structural steel whose physicals and weldability have been recently improved materially. Otto states that equal strength properties presumed, the same total weights could be secured with steel construction as with light metal alloys. Data and steel profiles employed are given with reference to the vehicle concerned. EF (14a)

Aluminium in Boat and Shipbuilding. G. W. LACEY. *Shipbuilding & Shipping Record,* Vol. 43, Jan. 18, 1934, pages 66-67. A discussion of the application of the aluminum alloys Duralumin, Alpax, Silumin, Birmabright, M. G. 7, and Hiduminium R. R. 66 in marine work with special reference to their properties, strength, treatment and resistance to corrosion in relation to such work. JWD (14a)

Most Important Structural Materials for Metal Aircrafts (Die wichtigsten Baustoffe von Metall-Luftfahrzeugen) W. ACKERMANN. *Die Umschau in Wissenschaft & Technik,* Vol. 38, Feb. 25, 1934, pages 166-168. The evolution of Duralumin is reviewed and its properties summarized. Skleron age-hardens at 20°C. and contains 12% Zn and 0.1% Li. Lautal, Aludur, Aldrey and Aeron are aged at 100°-150°C. Elektron, a Mg alloy containing 10% Al is equivalent to Duralumin in regard to physical properties, but is less corrosion resistant. Microstructures showing intergranular corrosion of Duralumin are given. Protective coatings of oil or cellulose lacquers, bituminous and metal coatings check atmospheric corrosion attack. Hydronalium, an Al alloy with 10% Mg shows remarkable corrosion resistance against seawater and alkalies. WH (14a)

Magnesium Metal for Treating Water (Magnesiummetall für Wasseraufbereitung) H. BACH. *Gesundheitsingenieur,* Vol. 56, Nov. 18, 1933, pages 545-547. Mg can be advantageously used for eliminating excess of chlorine in water which has been treated with hypochlorites or Cl_2 gas. The resulting $MgCl_2$ is soluble in water so that no passification of the filter takes place. Dechlorinating the water supply of a town of 100,000 inhabitants would cost 0.07 Pfennigs/m.^{3} H_2O, a water consumption of 200 l./capita/day and 0.5 g./m.^{3} free Cl_2 (= 10 kg.) in the water presumed. Mg chips and turnings are particularly suitable in physico-chemical and economic regard. Free CO_2 partly responsible for the corrosion of Fe pipe lines can be fixed by Mg metal. Data on laboratory tests are presented. The author calculates that the additional expenses for a water consumption of 20,000 m.^{3} H_2O/day containing 20 mg. free CO_2/l. would amount to 0.33 pfennigs, while the water price in Germany is 6-20 pfennigs/m.^{3} The increase of $MgCl_2$ and Mg bicarbonates in the drinking water due to the effect of a Mg filter is insignificant. Bach furthermore suggests the utilization of Mg filters for rendering (boiler) water alkaline. After fixing all free CO_2, hydroxyl-ions form. The pH value can be brought up to 8 and higher by Mg. WH (14a)

Duralumin in Modern Furniture (Le Duralumin dans l'Ameublement moderne) V. CHEILLY. *Cuivre et Laiton,* Vol. 6, Sept. 15, 1933, pages 419-421. The development of metal furniture and its influence on decorative art is discussed. French styles are described. Ha (14a)

Better Instrument Springs. ROBERT W. CARSON. *Electrical Engineering,* Vol. 53, Feb. 1934, pages 282-286. Characteristics and stability of performance of instrument springs are of prime importance; phosphor bronze which is used quite generally was investigated with respect to its suitability. The conditions and processes of manufacture which lead to most satisfactory performance are described. Ha (14a)

Benzene Synthesis from Carbon Oxide and Hydrogen at Ordinary Pressure. XI Tests on Co-Cu-Th and Co-Cu-U Catalyzers. XII Tests on Co-Cu-Th-U Catalyzers. XIII Investigations on Ni Catalyzers (1), (2), (3), (4) (Über die Benzinsynthese aus Kohlendioxyd und Wasserstoff unter gewöhnlichem Druck. XI. Versuche über den Co-Cu-Th und Co-Cu-U Katalysator. XII. Versuche über den Co-Cu-Th-U Katalysator. XIII Untersuchungen über die Nickel-Katalysatoren (1), (2), (3), und (4) Kenji Fujimura & Shunzo Tsuneoka. *Scientific Papers Institute of Physical and Chemical Research, Tokyo,* Vol. 22, Nov. 1933, pages 189-197, 198-201, 242-247, 248-253, 254-258, and 259-263. (In German.) These 6 papers present wealth of experimental data from extensive investigations into the suitability of various metals and over 100 metal combinations as catalyzers in the benzene synthesis. WH (14a)

Thallium and Its Compounds. Recent Developments in Production and Use. James C. Munch. *Chemical Trade Journal,* Vol. 93, Sept. 8, 1933, pages 173-174; Sept. 15, 1933, page 195. See "Recent Developments in the Preparation and Uses of Thallium," *Metals & Alloys,* Vol. 5, Mar. 1934, page MA 89. WHB (14a)

The Industrial Applications of Thallium and Its Compounds. *Journal Society Chemical Industry,* Vol. 52, Aug. 25, 1933, pages 687-689. Large-scale production of thallium compounds from zinc blende as a by-product of lead and zinc manufacture has decreased the price from $15/lb. in 1928 to $7.50/lb. in 1932. Aside from industrial uses, thallium alloys are of interest. Alloys of Ti and Ag have high lustre and remain untarnished on exposure to air. Tl-Al-Ag alloys are extremely resistant to chemical reagents including HCl and H_2S, the most satisfactory of which contained 10% Tl, 10% Al and 80% Ag. Addition of Ti to Pb-base bearing metals improves their resistance to deformation. Pb-Tl alloys are used for electrical fuses. Fe-Ni alloys with 0.1-5.0% Tl are used for "powder cores." The 10-20-70 Tl-Sn-Pb alloy is very resistant as an electrode in the deposition of Cu from acid solutions. VVK (14a)

What Is Block Tin Pipe? *Domestic Engineering,* Vol. 142, Dec. 1933, pages 112-113. Processes of manufacture discussed. Kz (14a)

Commercial and Economic Significance of Aluminum Foil as Heat Insulation Material (Technisch-wirtschaftliche Bedeutung von Aluminiumbronzefolien als Wärmeisolation) *Brennstoff & Wärmewirtschaft,* Vol. 15, July 1933, page 132. Tests of E. Schmidt at the Technische Hochschule Danzig verified the excellent heat insulation properties of Al foil ("Alfol") in comparison with diatomaceous earth and other insulation materials on the market. Alfol weighs only 1/10 of the insulation materials employed at present but shows 100% better insulation properties. EF (14a)

An Interesting Application of Copper: Distilling Columns (Une très Intéressante Application du Cuivre: Les Colonnes à distiller) G. DuBois. *Cuivre et Laiton,* Vol. 7, Feb. 28, 1934, pages 81-86. A brief history of the distilling column of Cellier-Blumenthal is given and the application of Cu for its parts recommended. Ha (14a)

Zinc Base Alloy Die Castings Find Steadily Widening Field of Automotive Application. Joseph Geschelin. *Automotive Industries,* Vol. 69, July 15, 1933, pages 72-76. Zinc base alloy die castings are used for decorative purposes in auto construction, in the production of different accessory items, and for many other purposes. The greater stability of the new alloys is the main reason for the wider application. In the early days lead and tin were considered as "specifics," and were actually put into the alloys. These 2 metals in the beginning were certainly not regarded as the worst type of contamination. Many fractures were experienced with die castings in warm tropical climates, but the advantages from the manufacturers' point were so outstanding, that users and die casters carried on despite difficulties. The development of high purity zinc, of the order of 99.99% purity, has made available a range of alloys which meets demands of automotive service. The writer sets down in a number of tables some common as well as unusual applications of zinc base alloy castings, the effect of normal aging upon certain critical physical properties of zinc alloys, and a comparison of the physical properties of certain zinc base alloys with those of other case materials. This comparison is of value to the engineer when considering whether a substitution of materials may be safely recommended. The writer also points out that an intensive research program is under way in many quarters. Briefly, it is being carried out along the following lines: (1) development of new alloys and manufacturing technique; (2) study of physical properties of these materials; (3) effects of aging; (4) effects of elevated temperature; (5) effects of atmospheric conditions. DTR (14a)

Electro-Magnets for Handling Materials (Electro-Aimants de Levage) Gérantes. *Arts-et-Métiers,* Vol. 85, Mar. 1933, pages 96-101. In first section, electrical theory for computing magnets is given. In second section, use of Cu and Al in windings are discussed. In last section, structures of magnets used in various cases are reviewed and illustrated. FR (14a)

Occurrence and Utilization of Some Rare Elements (Vorkommen und Verwendung einiger seltner Elemente) F. Hermann. *Die Metallbörse,* Vol. 24, Feb. 3, 1934, pages 145-146. (1) Be: 0.5 x 10^{-6}% of the earth's crust, occurrence, price = 600 R.M./kg. metal containing 99% Be and 1% Fe, crude beryl mineral = 150 R.M./ton. (2) Ga: 0.1 x 10^{-9}%, Mansfeld production = 60 kg. per annum cut down the price 1/18, i. e., to 10,000 R.M./kg.; utilization as thermometer material up to 1000°C. and in lieu of Hg in dental fillings. (3) Tl: 0.8 x 10^{-8}%, also experimented with in dental industry. Price = 1400 R.M./kg. (4) In: 9 x 10^{-9}%, used for medical purposes against sleeping sickness. (5) Rh: 1.0 x 10^{-9}%, utilized as catalyst and alloying element for noble metals. Present price = 15,000 R.M./kg. corresponding to $5,800 at the present exchange rate. EF (14a)

Coils. F. V. Hartman. *Domestic Engineering,* Vol. 42, Sept. 1933, pages 137-138. Discussion of methods employed in forming aluminum tubing. Kz (14a)

Aluminium Castings in Automobile Railway Car and Vehicle Construction (Aluminiumguss im Treibwagen und Fahrzeugbau) W. Hartl. *Verkehrstechnik,* Vol. 51, Feb. 5, 1934, pages 57-60. Fully discusses the subject under the following headings: (1) Weight saving possible by utilization of light metal castings. (2) Problems concerning materials and shaping processes. (3) Spring mounting and shock absorption. (4) Surface treatment and protective coatings. (5) Utilization examples and economy. Fatigue tests on structural members with and without intermediary rubber layers (damping) resulted in fracture after 7000 and 400,000-420,000 shocks. Corrosion fatigue tests revealed the favorable properties of Al-Si alloys. Additions of Cu, Zn, Mg in amounts exceeding 1% materially reduced the corrosion fatigue strength. Corrosion underneath protective paint coatings is not encountered with light metal alloys unlike Fe. Paint coatings adhere better on castings than on rolled material. Cr and Ni plated light metal alloys are inferior to plated parts of Cu or steel. High grade finishing of light metal surfaces yields a metallic lustre effect similar to plated material. 26 applications of light metal alloys in vehicle construction actually in use are listed and 13 representative illustrations presented. The initial costs, disregarding a few exceptions, are higher in the case of light metal constructions than with those in steel but the author claims the following advantages with reference to the special utilization discussed: (1) shorter driving times, (2) lighter motors or increase of pay load in case of equally strong motors, (3) saving in electricity, lubrication oil, coating and coating maintenance costs. WH (14a)

Unusual Sheet Metal Work on Airport. *Sheet Metal Worker,* Vol. 25, Jan. 1934, pages 40-41. The method of applying sheet Al to structural steel in the buildings of the Shushan Airport, La., without seams, bolts or screws showing is described and illustrated. Ha (14a)

Light Metals in Vehicle Construction (Leichtmetalle im Kraftfahrzeugbau) *Verkehrstechnik,* Vol. 51, Jan. 20, 1934, page 36. Due to its high torsional and bending strength, Duralumin is particularly suited for vehicle body construction. Duralumin bicycles weigh 4.7 kg. instead of 10.6 kg. for steel. The favorable heat dissipation from rubber tires mounted on Duralumin wheels is stressed, Silumin chill castings are now made at the price of gray cast Fe but the weight is greatly reduced. Elektron has a low spec. weight of only 1.8-1.83 is tough and strong and has a low impact strength. Elektron wheels withstand 50% larger compressive stresses than cast steel ones and weigh 50% less. A combination of Elektron and steel saves 41% of an all-steel wheel. Hydronalium, an Al alloy with 5-15% Mg is corrosion resistant, can be riveted and welded and shows the following physicals: tensile strength = 55-66 kg./mm.^{2}, yield point = 45-50 kg./mm.^{2}, elongation = 15-10%. If employed in combination with other alloys, electrolytic action is excluded by insulating layers of linen soaked in lacquer. WH (14a)

Copper for Water Lines (Kupfer für Wasserleitungen) L. W. Haase & O. Ulsame. *Die Umschau in Wissenschaft & Technik,* Vol. 38, Jan. 21, 1934, pages 64-66. Present low price, high strength and new joining possibilities increased the demand for Cu as pipe material. Salts, acids and bases present in the soil do not attack Cu. After a film of cuprous oxide has been formed, the dissolution of Cu is retarded. Cu_2O represents a rather stable compound. Cu offers a better material for pipe lines than Fe in the case of hard water which tends to form incrustations. Cu is also best suited to carry soft, aggressive cold water, but it should be dismissed in the case of acid water where the dissolving action of the liquid may surpass the formation of Cu_2O. In the absence of O_2, no metal goes into solution. The physiological effect of Cu on the human body is discussed at length. 1-2 g. Cu cause no poisoning. 0.1-0.2 g. Cu can be digested daily without harmful effects. Many of the foodstuffs contain appreciable quantities of Cu. WH (14a)

Substitute for Amalgam Fillings for Teeth (Ein Ersatz der Amalgamfüllungen für Zähne) *Die Umschau in Wissenschaft & Technik,* Vol. 38, Mar. 4, 1934, pages 183-184. Gallium melts at 39°C., is stable in boiling H_2O and not poisonous. Experiments to substitute amalgams by an alloy of Ga with Sn, Cd and Bi (melting point = 90°C.) were not successful due to too quick a hardening of the alloy. Cd is also poisonous when in contact with Au fillings. Recent tests of E. Feiler (*Zahnärztliche Rundschau,* 1934, No. 7) on a Bi-Ga alloy yielded better results. The alloy is worked in the mouth with hot tools. Tests on corrosion resistance, workability, adhesion, shrinkage, hardness and edge stability furnished excellent results so that the replacement of amalgams is predicted. WH (14a)

Tin-wrapped Cheese. *Tin,* Mar. 1934, page 7. Claimed that cheese wrapped in tinfoil will keep for an almost indefinite period. Ha (14a)

Ferrous (14b)

M. GENSAMER, SECTION EDITOR

Construction of a Compressed Air Pipe Line of 2500 Meters Length (Construction et Installation d'une Conduite d'Air Comprime de 2.500 Metres de Longueur) L. Perreau. *Arts-et-Metiers,* Vol. 85, Feb. 1933, pages 41-48. Pressure inside of tubes is 6.5 kg./cm.^{2}, test pressure is 12 kg./cm.^{2} (170 lbs./in.^{2}). Temperature varies from 90°C. to 20°C. below zero. Steel used has the following composition: C 0.09-0.12; Mn 0.40-0.45; Cu 0.3-0.5; P and S less than 0.05. Tensile strength is 36-40 kg./mm.^{2} and elongation (on 100 mm.) is 26-30%. Special devices are used allowing provision for thermal expansion. Details on construction are given. FR (14b)

The Uses and Applications of Stainless Steels. Walter M. Mitchell. *Iron Age,* Vol. 131, May 11, 1933, page 743, ad. sec. pages 12, 14. Paper presented at the "Stainless Steel Meeting" in New York. Gives interesting and useful account of the range of application of this material in light of present experience. VSP (14b)

How Steel Aids in Harnessing Colorado River. A. H. Allen. *Steel,* Vol. 93, Dec. 18, 1933, pages 21-24, 32. Deals with the Boulder dam development, with chief attention to the pipes for the hydraulic-power and outlet-works tunnels and the cableway for transporting and handling them. Will require 17,000 tons of reinforcing steel for concrete, 150 miles of 2-in. pipe for cooling concrete, and 50,000 tons of steel plates for the tunnel pipe. Cableway, which has a clear span of 1260 ft. and can handle 150-ton sections, comprise 6 main cables, with 3-in. diam. cable of locked-coil construction. Cable weighs 22 lbs. lineal ft. and has a breaking strength exceeding 500 tons. MS (14b)

Full Spoke Unit for Welded Wheel Drawn from Strip. A. H. Allen. *Steel,* Vol. 94, Mar. 5, 1934, pages 23-25. Describes manufacture of automobile wheels by the Cleveland Welding Co., Cleveland. Rims and full-formed spokes, drawn from strip steel, are bent to circular shape and flash welded. Rims are formed to the desired contour by 3 separate rollings. Spoke unit is riveted to the rim. Former is Cr plated, while latter is japanned and striped. MS (14b)

Welded Burial Vaults Immune to Water and Rust. A. H. Allen. *Steel,* Vol. 94, Mar. 26, 1934, pages 25-27. Describes practice of the Sozonian Vault Co., Bucyrus, O. Bell and base of vault are fabricated from 12-gage ingot-Fe or steel sheets. Top and sides of bell are formed from a sheet and this central piece and the 2 ends are assembled by oxy-acetylene welding on the outside and electric welding on the inside. Vaults are tested hydrostatically to insure air tightness. They are then bonderized and finished in porcelain enamel or hard baked varnish with wrinkle effect. MS (14b)

The Right Metal for the Right Job is Problem for Refractories Man. C. E. Bales. *Brick & Clay Record,* Vol. 83, July 1933, pages 22-23. An investigation as to the various materials used in machinery for making refractories seems to point to alloy steels as the best for wearing property. Cast Fe has a great resistance to wear but is mechanically not as satisfactory as for instance Cr steel. Ha (14b)

Light Construction in Building Railroad Cars (Leichtbau bei Schienenfahrzeugen) R. Colell. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 24, Mar. 4, 1934, pages 144-146. In describing new German constructions author shows how considerable savings in weight can be effected by extensive use of welding and better utilization of mechanical properties of steel. In certain cases it seems more economic to use pressed and welded steel constructions instead of applying more expensive light Al alloys. GN (14b)

Bearing Metals and Pressures. M. P. Dalton. *American Machinist,* Vol. 78, Mar. 14, 1934, page 211. A few examples of high-pressure bearings (locomotives, gun carriages, etc.) are described; experiments indicated that regardless of rotary or sliding movement the stationary journal should be harder than the moving part. The steel used had 0.8% C and a Brinell hardness of 500-600. The view is expressed that failures of bearings must often be ascribed to the elastic limit of the metal used not being high enough to stand a suddenly imposed overload. Ha (14b)

Reducing Cooling Costs in By-Product Plants. B. T. Du Pont. *Iron Age,* Vol. 131, May 4, 1933, pages 704-705, adv. sec. page 22. Discusses results of tests conducted on cast Fe internally finned sections in by-product cooling coils. The significant facts are: (1) Appreciable savings in first cost; (2) Reduction in space occupied; (3) Decrease in quantity of cooling water; (4) Cleaning costs cut in half; (5) Minor repairs practically eliminated; and (6) Increase in length of replacement cycle to 10 yrs. under conditions where steel pipes last 3 yrs. Includes table giving a comparison of installation, operating and replacement costs. VSP (14b)

Modern Prisons Made Breakproof by Special Steels. E. A. France. *Steel,* Vol. 94, Jan. 15, 1934, pages 21-23. "Prison steel" refers to those steel parts which are open to tampering with files, drills, blow-torches, etc. They are provided in both solid and laminated alloy steel bars, plates, and flats, with round bars and hexagons predominating. Almost all, however, are made up of plies, alternately of hard and soft steel. Designs usually embody 5 or 9 plies or 12 inserts. Plies are made of 2 types of steel. Most generally used type contains 1.00-1.10% C and 0.30-0.40% Cr. Other is a nonannealable steel possessing self-hardening properties. Both should be heat treated. In manufacturing prison steels, inserts are first assembled to form a cage based on a steel ring. Cage is inserted into ingot-mold, by suspending from the top, and molten soft C steel is bottom cast about it. MS (14b)

What the User Should Know About Free-Cutting Steels. H. W. Graham. *Iron Age,* Vol. 131, June 8, 1933, pages 903-904, adv. sec. page 12. Taken from a paper read before the Baltimore chapter of the American Society for Steel Treating. Discusses the effect of S content on free-cutting steels, the competition of the open-hearth with Bessemer converter for making these steels, factors which make for free-cutting, behavior in heat treating and economic importance of using the cold-finished product. Includes a table giving the compositions of Bessemer and open-hearth screw steels. VSP (14b)

Rail Joints and Their Maintenance. William E. Gadd. *Railway Engineering & Maintenance,* Nov. 1933, pages 548-549. Discusses various practices and stresses importance of proper application and upkeep. WH (14b)

Oil Pipe-lines. A. C. Hartley. *Mechanical World & Engineering Record,* Vol. 94, Dec. 8, 1933, pages 1176-1177. Very long pipe lines are subject to heavy expansion loads. A successful type of joint is described and the composition of a suitable pipe material is given as follows: 0.05-0.15% C, 0.30-0.60% Mn, max. 0.06% P, max. 0.06% S, max. 0.20% Si. The pipes were lap welded. During the past few years welding has been increasingly used for repair work on pipe lines. Kz (14b)

To Pave English Tunnel with Cast-Iron Blocks. *Steel,* Vol. 94, Jan. 8, 1934, page 43. From *Overseas Engineer.* Mersey tunnel between Liverpool and Birkenhead will have 50,000 sq. yds. of road surface formed of cast-Fe sections, the studs of which are hardened by a special chemical process in casting. MS(14b)

Tin Can "King for a Day" in Nation's Steel Consumption. *Steel,* Vol. 94, Jan. 15, 1934, pages 10-11. Analysis of steel consumption in the container industry. Includes chart showing consumption in gross tons from 1922 to 1933. Since 1924, it has never been less than 1,000,000 tons annually. In 1933, it was 1,682,998 tons only 563 tons less than the peak in 1929. MS (14b)

Pinless Clothesline Made of Steel Wire Rustproofed by Galvanizing. *Steel,* Vol. 94, Jan. 29, 1934, page 30. Introduced by Price Mfg. Co., Chicago. Middle of a 41" length of wire is coiled and the ends are bent at opposite right angles to form a 1-ft. link. Hooks produced by bending join link with the coiled section of the adjoining link, the 2 wires being given 1 twist to provide the spring action necessary to hold the ends secure and the clothes to the line. 25-ft. line weighs 2 lbs. MS (14b)

Highway Guard of Steel Pipe Deflects Runaway Cars Back onto Road. *Steel,* Vol. 93, Nov. 6, 1933, page 42. Machined Steel Casting Co., Alliance, O., has developed a highway guard comprising a horizontal pipe of 4-in. outer diameter, mounted on suitable bearings which permit it to rotate freely. Pipe is supported by heavy rolled steel standards rigidly bolted to a concrete base or it is mounted on a highway fence. MS (14b)

Large Uses of Steel in Small Ways. No. 254-257. *Steel,* Vol. 94, Jan. 22, 1934, page 34; Feb. 12, 1934, page 35; Mar. 5, 1934, page 34; Mar. 26, 1934, page 42. Deals with oily waste cans; "C" clamps; tool holders; and gaskets. MS (14b)

Stainless Equipment. *Oxy-Acetylene Tips,* Vol. 13, Apr. 1934, page 89. Brief description of some brewery equipment of stainless steel. Ha (14b)

Alloy Steels in European Mining Equipment. *Mining Congress Journal,* Vol. 20, Jan. 1934, page 33. Excerpts from article in *Revue du Nickel,* Apr. 1933. Cites examples of the use of nickel alloy steels with 2 to 3.5% Ni, and nickel chromium steels, for car axles, couplings, suspension bars, pins, and nuts. Increased safety, reduced weight of equipment, and high resistance to wear and shock are some of the advantages gained. BHS (14b)

Recent Progress in Steel Alloys. *Journal of Commerce (Shipbuilding and Engineering Edition),* Jan. 25, 1934, pages 1-2. A review of recent applications of stainless steels to marine work for corrosion resisting purposes, to the use of nitrided steels, to developments in tool steels and cutting alloys and to the use of alloy steels for such purposes as chains, tools, and other parts. JWD (14b)

Steel Supersedes Wood in the Construction of Barrels for Beer. *Iron Age,* Vol. 132, Dec. 28, 1933, pages 22-24. Describes the manufacture of steel barrels by the Buhl Stamping Co., Detroit. The barrel consists of an inner and outer shell spaced about ½ in. apart with space filled with insulating material. Design is such that thermal insulation is equal to that of wooden barrels. Welding is important in the construction. Cites advantages of steel over wooden barrels. VSP (14b)

Many Castings Are Used in Largest Testing Machine. *Foundry,* Vol. 61, Sept. 1933, pages 38, 40. Describes the use of castings in the construction of the world's largest machine for testing materials. The machine was constructed by the Baldwin-Southwark Corpn., Philadelphia, for the University of California. All castings were made by the Standard Steel Works Co., Burnham. VSP (14b)

The Application of High Grade Steel in Reinforced Concrete. Fritz Emperger. *Structural Engineer,* Vol. 11, Dec. 1933, pages 475-477; discussion, C. G. Lynam, Feb. 1934, page 116; *Structural Engineer,* Vol. 12, Mar. 1934, pages 160-178; discussion, pages 178-183. Lecture before the Institution of Structural Engineers, London, Dec. 1933. Large scale experiments in Germany and Austria showed conclusively that even with the highest grade of steel available in the market today the strength of concrete is normally in such excess over that of steel, that, using normal concrete of 2,000 lbs./in.^{2} and ordinary percentages of reinforcement, it is superfluous to restrict the concrete stress when making the calculation. Diagram shows testing results gained on concrete specimens containing steel and concrete of known strength. It reveals that the line of failure does not follow that of the yield point of the steel as the percentage of reinforcement increases until it reaches the intersection of the line of the concrete. Lynam states that the physical properties of steel are not altered by encasing it in concrete and that the "real modulus of elasticity is much larger than is commonly assumed." Part II. The use of high yield point steel in reinforced concrete cannot be economical without high permissible stresses which brings up the problem of endangering the permanency of reinforced concrete structures. The viewpoints in extensive tests the results of which are given in some 25 illustrations cover (A) the safety factor of the permissible load as against the breaking load and (B) the limiting of the permissible stresses in order to avoid dangerous cracks. The greatest progress achieved in reinforced concrete in the last few years are (1) the use of systems of wire nettings with permissible stresses up to 34,000 lbs./in.^{2} and (2) the Isteg steel, which is a reinforcement made of 2 mild steel rods, twisted together under conditions in which the ends are fixed. By this operation the so-called yield is taken out of the steel. While the breaking strength is merely a symbol of the strength of the steel, the yield is of paramount significance since the elongation connected with yield results in the collapse of the structure. Conclusions: we have no steel to match the concrete. Reduction of restrictions imposed on concrete are necessary. Restriction of the permissible stresses to not less than half the yield point of the steel is desirable (max. yield point = 60,000 lbs./in.^{2}) if there is no danger of laying the steel bare. WH (14b)

Box Section Side Rails Triple Stiffness and Save Weight in New Studebaker Frame. Joseph Geschelin. *Automotive Industries,* Vol. 69, Sept. 30, 1933, pages 396-399. Studebaker's 1934 line has been mounted on a box type frame, adopted after a survey of current European practice. Results of torsion and shear tests of 3 types of frames, carried out on Midland Steel chassis machines, are discussed. DTR (14b)

Cast Iron Flaggings in Plants Handling Costly Materials (Les Dallages en Fonte dans les Manutentions de Matériaux de Prix) J. Dhavernas. *La Fonte,* Vol. 2, Jan. 1933, pages 251-253. Cast Fe flags are shown preferable for making floor when it is a matter of handling costly materials particularly if these are in pulverized state and if trucks have to roll on the floor of the plant. Example of application of cast Fe flaggings is described for a plant of La Nèthe in Belgium where nickel matts from New Caledonia are treated. With the French process, Ni oxide is pulverized before being sintered for reduction and it is important to recover lost dust which falls on the cast Fe pavements. Furthermore, it is estimated that annual savings obtained in transportation and handling are higher than cost of flaggings themselves. FR (14b)

The Development of Water-Tube Boilers. C. H. Davy. *Inspection,* Vol. 4, Jan. 1933, pages 1-46. Includes discussion. Paper read before the Institution of Engineering Inspection Nov. 9, 1932. After discussion of various types of boilers and the latest developments in design the application of riveting, forging and welding in the production of boiler drums is dealt with. Material subjected to high stress during the manufacturing process is readily attacked by chemical embrittlement and metal fatigue. Welding offers the advantage of stress relieve after fabrication. In the U. S. A. and Germany there has been a marked fall in the production of riveted drums, particularly for those with pressures exceeding 150 lbs./in.^{2} Methods of inspection of boiler drums are touched upon. Changes in physical properties of materials used in the manufacture of boiler pressure parts between temperatures of 400-800°F. are discussed. Experience has shown that mild steel can scarcely be considered a reliable material for superheated tubes where a final steam temperature in excess of 840°F. is required. At this temperature the resistance of mild steel to creep is very much reduced, and there is a distinct liability for spheroidization of the carbide. Alloy steel tubes are recommended having a high Ni and Cr content together with some percentage of elements as W or Ti to act as a stabilizer and prevent intercrystalline breakdown at working temperature. Kz (14b)

The Metallurgists' Contributions to Automotive Development. P. M. Heldt. *Automotive Industries,* Vol. 69, July 15, 1933, pages 64-68. The writer has discussed this subject of progressive automotive development thoroughly. Primarily the alloy steel industry was developed to meet the need for better materials of construction for automobiles. After mentioning heat treatment and nitriding, the writer points out the importance of a small amount of Al in all grades of nitralloys. The use of Ti in cast iron, and the extensive applications of Zn alloys and Al and Mg alloys are discussed. Although there have not been any revolutionary developments in bearing materials, yet all the improvements in Sn-base white metal alloys may be ascribed to the progressive research work done by the metallurgist. DTR (14b)

The Common Carbon Steels. J. R. Miller. *Heat Treating & Forging,* Vol. 20, Feb. 1934, pages 76-79. Points out that these steels could be used more extensively for purposes for which they are now considered inferior if producers would engage in research to improve their composition and treatment. MS (14b)

Steel Frame Is Essential in Modern Home Construction. Alexander Miller. *Steel,* Vol. 94, Feb. 5, 1934, page 32. From an address before the Brick Manufacturers' Association, Jan. 24, 1934. Steel-frame construction of residences provides a fireproof and non-shrinkable frame and a home which is safe in thunderstorms and resistant to earthquake shocks. Flexibility in design is possible. Standard sections can be used in construction. MS (14b)

Breaks in Cast Iron Pipe Gridiron Systems. W. C. Mabee. *Journal American Water Works Association,* Vol. 24. Nov. 1932, pages 1717-1723. A record of the causes of 222 breaks in the cast iron pipe gridiron system of the Indianapolis Water Co. over a period of 35 years, 1897-1931, yielded the following:

Settlement	26.1%
Electrolysis	30.6%
Increased Pressure (fire pressure)	7.2%
Vibration	7.2%
Improper care by others (after pipe is exposed)	6.8%
Defective pipe	5.9%
Freezing	4.0%
External blow	3.6%
Flood	4.5%
Water hammer	1.8%
Miscellaneous and unknown (including soil corrosion)	2.3%

VVK (14b)

Design and Manufacture of Large Gears For Industrial Service. Thomas Holloway. *Iron Age,* Vol. 131, June 29, 1933, pages 1020-1023, adv. sec. page 14. Part of an address read before the American Gear Manufacturers Association. Outlines the designing and making gears of large size and weight for modern rolling mill drives. Manufacturing processes illustrated cover gears weighing as much as 138 tons, the teeth of which are cut by a special form milling machine. A horsepower formula used in designing the gears is given. Includes a number of tables. VSP (14b)

The Development of Materials for Poppet Valves. C. C. Hodgson. *Metallurgia,* Vol. 9, Feb. 1934, pages 115-116, 114; Mar. 1934, pages 141-143. Valve requirements are discussed. Different valve steels are described and their advantages and disadvantages pointed out. There is no best valve steel because requirements are different for different engines. Austenitic Ni-Cr steels are used where strength at high temperatures is of great importance. Si-Cr steels have the greatest resistance to burning and scaling. High-C, high-Cr steels offer the greatest resistance to stem wear. A thin layer of Stellite on valve and seat is helpful. JLG (14b)

The Metallurgical Aspect of Coal-Face Machinery. J. R. Jenkinson. *Colliery Engineering,* Vol. 10, July 1933, pages 231-233. Brief discussion of the behavior of metals in service and the procedure adopted in the examination of components that have been in service for certain periods of time. Mainly dealt with are cutter chains each unit of which is a machined drop-forging, which is heat-treated according to the composition of the metal, usually low-carbon, Ni, Ni-Cr, or Ni-Cr-Mo case-hardening steel. Another class consists of a Ni-Cr steel suitably oil-quenched and tempered. The essential of coal-cutter chains to possess durability and strength has led most manufacturers to choose case-hardening steels. Discussion of failures of machine parts used in coal-mining. Kz (14b)

Steel as Material for German Road Construction (Stahl als Werkstoff für den deutschen Strassenbau) A. Kufferath. *Die Metallbörse,* Vol. 23, Nov. 25, 1933, pages 1501-1502. Discusses from economic viewpoint the laying out of steel-grate high-ways in Germany. Three different bituminous materials are employed to insure corrosion stability which is not taken for granted by some authors. Cast Fe previously used for road construction yields a greater corrosion resistance but shows inferior strength. The cost of the new speedways are 8-9 R.M./m.^{2}, including 0.13 R.M./kg. steel and 1.00-1.50 R.M./m.^{2} welding expenses. The advantages of this new type of road construction which demands a great quantity of steel, are set forth. EF (14b)

Patina-Steel, a Rust Resistant Building Steel (Der Patina-Stahl, ein schwerrostender Baustahl) Kühle. *Der Bautenschutz,* Vol. 4, May 1933, pages 56-57. The addition of 0.2-0.3% Cu results in the formation of a film of metallic Cu under the rust, thus protecting the steel from further corrosion. Discussion of the application of the steel in building construction. The steel shows a greater resistance to flue gases up to 450°C, but is not in every case immune to soil corrosion. Kz (14b)

New Cement Lined Wrought Pipe Has Broad Industrial Application. *Iron Age,* Vol. 131, May 11, 1933, page 747. Describes a new cement lined wrought Fe pipe known as National "Duroline" pipe. Promising fields of application are foreseen in power plants, steel mills, sewage disposal, paper mills, etc. It was developed by the National Tube Co., Pittsburgh, Pa. VSP (14b)

Report of Preliminary Investigation of Thermal Properties of Porcelain Enameled Steel. *Enamelist,* Vol. 11, Feb. 1934, pages 11-12, 24. Tests were made to find out, by comparison with insulite or celotex, whether the insulating value of porcelain enameled sheet steel was sufficient to warrant further study. It was found that #18 gage steel tested was about ⅔ as good as ½ in. of insulite in preventing heat-leak from the inside of a house to the outside on a cold still day; and about half as good in preventing heat-input into a house from sunshine. Ha (14b)

Low Hysteresis and Stable Materials for Telephone Industry (Isoperms) (Hysteresearme und stabile Werkstoffe für die Fernmeldetechnik, Isoperme) O. Dahl & J. Pfaffenberger. *Zeitschrift für Technische Physik,* Vol. 15, No. 3, 1934, pages 99-106. Operating conditions of devices for telephony and telegraphy over long distances have necessitated certain magnetic properties of the iron parts used in these devices, e.g., original permeability, constancy of this permeability under varying magnetizing conditions in service, hysteresis loss, etc. The behavior of different materials available for this purpose are reviewed and their magnetic characteristics compared. The investigation of alloys in connection with suitable thermal and mechanical treatment has finally led to an alloy of 40% Ni, 60% Fe with up to 15% addition of Cu which when cold-deformed 90% gives a material which simplifies design and reduces size of induction (Pupin) coils. 7 references. Ha (14b)

Material Requirements for Telephone Industry, in Particular for the Design of Pupin Coils (Die Werkstofforderungen der Fernmeldetechnik, unter besonderer Berücksichtigung des Pupinspulenbaues) R. Goldschmidt. *Zeitschrift für Technische Physik,* Vol. 15, No. 3, 1934, pages 95-99. The magnetic properties of materials used in the design of devices and instruments for telegraphy, telephony and radiotechnique, are explained. The method to obtain certain characteristics of performance by using solid or powdered materials and materials like invar and isoperm are described. 16 references. Ha (14b)

Novel Magnetic Materials for Pupin Coils. Materials of Highest Magnetic Stability. Isoperms (Neuartige magnetische Werkstoffe für Pupinspulen. Materialien höchster magnetischer Stabilität. Isopermen) O. Dahl, J. Pfaffenberger & H. Sprung. *Elektrische Nachrichten Technik,* Vol. 10, Aug. 1933, pages 317-332. The characteristic properties of a core, initial permeability, stability, and losses due to hysteresis, residual effects and eddy currents are critically discussed with emphasis on the various metallic materials. Diagrams are presented showing the effect of cold rolling from 0-95% upon the magnetic properties (initial permeability, hysteresis and instability) of Fe (0.04% C), steel (0.5% C) and Ni. Further set of curves reveal how these 3 magnetic properties are affected by 90% cold rolling with reference to Fe-Ni alloys (0-100% Ni) in the air cooled, furnace cooled and water quenched state. The influence of rising degrees of cold deformation on the magnetic properties is graphically expressed in the case of FeNi with 40% Ni, Fe, and Fe-Ni-Al alloys containing 1.5%, 3% and 4% Al. At 5% Al cold deformation of 90% is not feasible. Fe-Ni-Al alloys with 3-4% Al yield a core material which can be worked satisfactorily into sheets of low hysteresis properties and excellent stability. The relative change of permeability after d.c. magnetization is graphically shown for Fe-Ni alloys (25% deformation) and ternary Fe-Ni-Al alloys with 3.4% Al. (90% deformation.) The technical difficulties involved in handling Al bearing Fe-Ni alloys are not encountered if Al is replaced by Cu. Four tables compile magnetic data gained on 40/60 Ni-Fe alloys containing 0-11% Cu, 4 and 12% Mn, 9% Cr, and 5% Si respectively. Hysteresis loops gained on W steel, perminvar, laminated cores, Al-Ni-Fe isoperms and Cu-Ni-Fe isoperms are presented. The analogy of the magnetic curves secured on the newly invented alloys and on Ni under stress is pointed out. The original paper must be consulted for the wealth of data revealing the drastic effects of mechanical deformation and thermal pre-treatment in the isoperm alloy groups which surpassed the previously employed laminated cores in magnetic and structural regard. EF (14b)

Reinforcement of Orival Bridge (Le Renforcement du Viaduc d'Orival) E. Fredet. *Arts-et-Métiers,* Vol. 85, Mar. 1933, pages 83-87. Reinforcement of a metal bridge 284 m. long. This railway bridge had been built in 1863 and was not strong enough to resist intensified traffic. Methods used are described. FR (14b)

Steel Capstan (Der Stahlgöpel) J. Hoffmann. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 24, Mar. 4, 1934, pages 149-150. Description of a steel made capstan, simple in attendance and operation, of high durability and efficiency, light in weight. GN (14b)

Steel Never Fails. V. G. Iden. *Heat Treating & Forging,* Vol. 20, Mar. 1934, pages 138-139, 141; *Steel,* Vol. 94, Feb. 12, 1934, page 16. Parts of an address before the annual conference of the Iron, Steel and Allied Industries of California, Feb. 8, 1934. Discusses some new uses of steel and recent developments in steel construction. MS (14b)

Selecting Steels for Industrial Gearing. T. R. Rideout. *Machinery,* N. Y. Vol. 40, Jan. 1934, pages 268-271. A number of case-hardening and full-hardening steels for gears and their particular properties and fields of application are enumerated. General requirements of steels for gears are discussed briefly. Ha (14b)

Wrought Iron. Robert W. Morrell. *Marine Engineering & Shipping Age,* Vol. 38, Oct. 1933, pages 360-367. Especially in vessels carrying refined petroleum products in bulk, the corrosion of the structural hull material is rapid and combined with the action of air and salt ballast water constitutes a set of conditions conducive to accelerated corrosion. The application of corrosion-resisting material in the hull structure of tankers appears essential and the author shows how the substitution of wrought-iron plates for steel effects a saving in annual expenses of approximately 15%, in spite of the increase in the hull weight by about 4.2% and initial costs of about 6%. Kz (14b)

Iron Shielding for Telephone Cables. H. R. Moore. *Electrical Engineering,* Vol. 53, Feb. 1934, pages 274-280. If a Pb-sheathed cable is provided with a steel armor or is installed in iron pipe conduit there is a lessening of magnetically induced voltages. A method is outlined for the quantitative prediction of the electromagnetic shielding effected by such iron-surrounded telephone cable sheaths, experimental verification of its applicability, and the necessary impedance data for its utilization. WHB (14b)

Steel Fitted to New Method of Caisson Construction. B. J. Osborne. *Steel,* Vol. 94, Feb. 19, 1934, pages 26-27. Describes construction and sinking of cellular caissons for piers supporting the San Francisco-Oakland bridge. Tabulates dimensions and tonnages of plates and shapes involved in each of the 7 being built by the author's firm. A total of 9,046 tons of plates and 3,754 tons of shapes is required. Electric arc welding will be used in the major portion of the structural work, over 60 miles of welding being required. MS (14b)

Steel Pavements Being Tested in Germany. *Excavating Engineer,* Vol. 28, Jan. 1934, page 27. **Steel Paving Is Tried in Germany,** *Steel,* Vol. 94, Feb. 19, 1934, page 25. Section of a street in Düsseldorf was paved with steel grates, each 19½ ft. long and 3¼ ft. wide and weighing 397 lbs. Units are either bolted or welded together and the depressions and grooves filled with macadamized tar, which is reinforced with steel strips. Cost is estimated to be 8-9 marks/m.^{2} Writer recalls that a steel company in Sault Sainte Marie, Ont., some 10 years ago laid a 200-yd. stretch of ⅛-in. thick solid steel plate paving. MS (14b)

Large Plates of 18-8 Clad Steel Are Used in Building Rotary Dryer. *Steel,* Vol. 94, Mar. 26, 1934, page 32. Describes dryer built by C. O. Bartlett & Snow Co., Cleveland, Ohio. MS (14b)

GENERAL (15)

RICHARD RIMBACH, SECTION EDITOR

Statistical Methods in Metallurgy (Die Anwendung der Grosszahlforschung in der Hüttenkunde) O. Hengstenberg. *Technische Mitteilungen Krupp,* No. 4, Dec. 1933, pages 112-117. Discusses advantages of employment of statistical methods in metallurgical and laboratory processes and illustrates it by examples of determination of heating value of gases, frequency curves of mechanical properties as dependent on composition of steel, quality of tools, etc. Ha (15)

Research on Metals and Alloys F. C. Frary. *Industrial & Engineering Chemistry,* Vol. 26, Mar. 1934, pages 281-284. A review of some of the important considerations involved in the production of a new commercial alloy, with emphasis on the effect of impurities in metals, workability in relation to crystal structure and annealing, the problem of melting metals, the "customers' problems" dealing with the utilization of the finished product, casting processes, and corrosion resistance. MEH (15)

Recent Progress in Drafting A. S. T. M. Specifications for Steel Castings. R. A. Bull. *Steel,* Vol. 93, Oct. 2, 1933, pages 30-32,34; Oct. 9, 1933, pages 28, 30, 32, 35. Describes and interprets the more important events that have preceded, influenced, and attended the adoption of the existing tentative standard specifications of the American Society for Testing Materials. MS (15)

Iron and Steel Developments in 1933 H. M. Boylston & G. M. Cover. *Fuels & Furnaces,* Vol. 12, Jan.-Feb. 1934, pages 6-10. A brief review of progress in melting and heat-treating practice, metallurgical scientific work, and equipment. Ha (15)

Occupational Diseases of the Mouth. H. B. Baum. *Journal American Dental Association,* Vol. 21, Feb. 1934, pages 247-254. The metals which may cause occupational diseases of the mouth are As, Bi, Hg, Ag, Pb, Zn, Sn, P, and Sb. Symptoms and industries in which these diseases have been reported are given. OEH (15)

Recipes for the Machine and Metal-working Industries (Rezepte für die Maschinen- und Metallwaren-Industrie) H. Krause. Max Jänecke Verlag, Leipzig, 1934. Paper, 5¾ x 8¼ inches, 232 pages. Price 4.50 RM. This, the third edition, of this book has been enlarged. The recipes included in the book were accumulated by the author as publisher and editor of technical publications. The recipes cover melting, pouring, molding, charging and alloying, working of metals, hardening, drawing, annealing, aging, soldering, welding and other methods of joining, surface working by grinding, polishing, tumbling, degreasing, pickling and electroplating, galvanizing, coloring, lacquering.

The recipes were not tested by the author but he states an effort was made to choose only those from reliable sources. The book contains 501 recipes and has a very complete subject index. Richard Rimbach (15)-**B-**

America Self-Contained. Samuel Crowther. Doubleday, Doran & Co., Inc., Garden City, 1933. Cloth, 5½x8¼ inches, 340 pages. Price $2.00. Among a growing number of thoughtful citizens the idea of American national self sufficiency is making strong and rapid headway. The ablest proponent of this theory is Mr. Samuel Crowther, who presents in this book an analysis which appears to the casual reader to possess common sense and logic. Both advantages and disadvantages of the scheme are discussed.

The reader's reaction depends, of course, on his point of view as influenced by his immediate economic concerns. One whose living now depends on the business of importing or exporting, for example, will view the idea with horror. But to the citizen who can rise above personal considerations and view the situation as it affects the total welfare of the whole country, the logic of economic nationalism as so ably explained will make a profound appeal.

It is no selfish nationalistic policy that Mr. Crowther advocates. It is not aggressive and would tend to reduce rather than increase the danger of wars such as have in the past developed out of the fierce competition among nations for foreign markets. With an America operating under a balanced economy—growing and mining and manufacturing the commodities and goods we as a people need and can consume—there is the hope of keeping things stable and steadily raising the standard of living of all our people.

We now have a world in which nearly all the nations have quantities of raw materials and manufactured goods to sell and very little need to buy, Mr. Crowther says, "The change is a permanent one. The export trade of the world is going the way of the whaling trade, and there is just as much chance of restoring it as there is of restoring the whaling trade by cutting out electricity and decreeing the world wide use of sperm oil." We have discovered that it does not pay to continue to lend money abroad with which foreign nations can buy our goods unless we are willing to accept an equivalent amount of their goods in return. Until such time, therefore, as we develop a World State, it seems best to confine our international trade to such things as we cannot produce ourselves, coffee, tea, silk, rubber, tin, and such items—and of these there are some that we are developing processes to make synthetically.

Mr. Crowther's book should be widely read, for it will bring understanding of many things that have heretofore been vague in the mind of the average man—things of vital importance to all of us. Kenneth Reid (15)-**B-**

Is There a Test for Machinability? H. W. Graham. *Metals & Alloys,* Vol. 5, May 1934, pages 93-95. Case history recounts the value of negative results obtained over a period of 15 years attempting to relate hardness, work hardening characteristics, ratio of tensile to shear strength, milling cutter results, drilling and ultra rapid photography of metal cutting operations with the machinability of Bessemer screw stock. Measurements of power required by a screw machine and metallographic studies were without relation. Though there have been many disappointments and much negative data developed real progress in the production of free cutting steels has been made. WLC (15)

Application of Statistical Methods in Practical Cupola Furnace Operation (Die Anwendung der Grosszahlforschung im praktischen Kupolofenbetrieb) K. Neustaetter. *Die Giesserei,* Vol. 21, Feb. 16, 1934, pages 71-74. Investigation by statistical methods is a process eminently suitable for investigating conditions in rough operations as in foundries, etc. An example of a cupola furnace operation illustrates how conditions and factors which are not at once obvious in their influence on operation can be related to the general operation. Ha (15)

Light Metal Developments in 1933. *Mining Journal, Annual Review No.,* Vol. 184, Feb. 17, 1934, pages 16-17. Al output increased over 1932. A method for production of Al from kaolin is described. Use of Al and Mg alloys is discussed briefly. AHE (15)

Steelworks Adds to Research Facilities at Youngstown. *Steel,* Vol. 94, Mar. 12, 1934, pages 30-31. Describes new metallurgical laboratory at the Ohio works of Carnegie Steel Co. MS (15)

Probability in Tin-Plate Practice. Carl B. Post. *Metals & Alloys,* Vol. 5, May 1934, pages 89-92. From curves of relative frequency vs. test values a table is constructed showing the probability of a box of 200 sheets containing various percentages of sheet with tests below a certain value. If a box is selected and 3 sheets withdrawn for test the probability of the box containing certain percentages of sheets changes and is different according to the tests from these 3 sheets. A second table is constructed showing the effect of the findings of the test upon the probability as to the percentage of bad sheets in the box. The application of probability study to the effect of high P on the ductility of tin-plate is briefly discussed. A mathematical appendix discusses the various formulae and mathematical methods. WLC (15)

Development of Adnic, A Corrosion and Heat-resisting White Metal Alloy. William B. Price. *Metals & Alloys,* Vol. 5, Apr. 1934, pages 71-73. This research case history shows a problem divided into 2 stages, (1) testing by engineers of all available alloys and (2) the inspection of their results by metallurgist and the use of their methods of tests to develop under strictly control conditions an alloy that would give the required properties. 6 references. WLC (15)

Casting and Welding—or Compressing and Sintering? (Giessen und Schweissen—oder Pressen und Sintern?) Joh. Mehrtens. *Automobiltechnische Zeitschrift,* Vol. 37, Mar. 10, 1934, pages 131-132. A new method of obtaining formed pieces without casting is described which is said to be a serious competitor to casting or welding as practically no waste or rejects occur. Metal powder or fine chips, with additions if required, are sintered (fritted) together by high-frequency current without first melting the material as in the usual methods; the eddy currents produced by the high frequency unite the metal powder or grains whereby a porous, spongy structure of great strength is produced. The material is called "capillary metal" or "sinter bronze" or also "fritted metal." It is suited particularly for friction bearings as the porous structure fills with oil over the whole piece, and in Germany has found use in automobiles. Ha (15)

Ford Champions the Small Plant. Burnham Finney. *Iron Age,* Vol. 131, May 4, 1933, pages 695-697. Henry Ford visualizes the breaking up of large industries into small plants about the countryside. During past decade he has established 7 such plants within a radius of 20 miles, employing from 12 to several hundred workers. This plan gives employees many advantages. This is a practical demonstration of Ford's theory that industry and agriculture must be more closely allied. VSP (15)

Scrap Iron Broken in Blasting Pits. Rudolph Feuchtinger. *Iron Age,* Vol. 131, May 11, 1933, page 735. Abstract of paper in *Explosives Engineer.* Describes armored blasting pits for breaking scrap Fe to furnace size as used in Germany. VSP (15)

Economic (15a)

Possibilities of Increasing the Gold Production of Canada. H. C. Cooke & W. A. Johnstone. *Engineering,* Vol. 136, Nov. 17, 1933, page 552. From paper read before Section C of the British Association, Sept. 13, 1933. LFM (15a)

Self-Sufficiency of German Metal Industry on German Material (Aufbau der deutschen Metallindustrie aus deutschen Werkstoffen) Guertler. *Oberflächentechnik,* Vol. 11, Jan. 16, 1934, pages 16-17. The question is discussed how the existing metal raw materials in Germany suffice for meeting the whole demand on light metals (Al, Mg), hard metals (W, Mo, Ta), heavy metals with high melting points (Fe, Ni, Cu) and with low melting points (Zn, Pb, Sn) and rare metals, besides about 30 more metals used for alloying. To be independent, steel structures would have to be replaced to the greatest extent by light metals, steels remaining mainly for tool steels and high quality (stainless, etc.) steels. Also Cu in the electric industry can be replaced by Al which can be had in any quantity. Ni can be replaced by certain combinations of Cu-Ni, Fe-Mn, etc., also by Cr. Cr can be replaced in steels by Si, Mo, W. Ag is hardly required, as also Au. To carry out such program many new metallurgical problems will have to be solved. Ha (15a)

The Evolution of the Zinc Industry. J. A. French. *Metal Industry,* London, Vol. 44, Jan. 12, 1934, pages 34-36. Brief historical sketch of use; distribution of production with particular respect to the British Empire, uses of Zn, mostly as brass, protective coating of metals, manufactured products, are discussed. Ha (15a)

The British Foundry Industry in 1933 (Die britische Giessereiindustrie im Jahre 1933) V. C. Faulkner. *Die Giesserei,* Vol. 21, Apr. 13, 1934, pages 158-159. Review of ferrous and non-ferrous foundry activity; a general improvement over the preceding 3 years could be stated. Ha (15a)

The Fallacy of Average Flat Prices for Castings. F. N. Flynn. *Metal Industry,* N. Y., Vol. 32, Feb. 1934, page 47. A schedule is given showing price differentials for various weights per casting, either solid or with dry sand cores. This is used in place of quoting an average price per pound for all work. PRK (15a)

Nickel in 1933. *Mining Journal, Annual Review No.,* Vol. 184, Feb. 17, 1934, page 13. Canadian Ni output increased from 15,164 short tons in 1932 to 42,293 tons in 1933. AHE (15a)

Copper in 1933. *Mining Journal, Annual Review No.,* Vol. 184, Feb. 17, 1934, pages 11-12. World Cu production is estimated as 1,199,171 short tons. Stocks were reduced from 788,598 to 640,259 tons. AHE (15a)

Tungsten in 1933. *Mining Journal, Annual Review No.,* Vol. 184, Feb. 17, 1934, page 13. W output was about 11,000 tons in 1933. AHE (15a)

Year Ends Worse Than It Began for Belgium. *Steel,* Vol. 94, Jan. 1, 1934, pages 171, 174. Reviews conditions in the iron and steel industry during 1933. Gives statistics on average monthly production, imports, and exports for 1913, 1930—Oct. 1933, including those for Luxemburg. MS (15a)

Canada Starts to Come Back in 1933. *Steel,* Vol. 94, Jan. 1, 1934, pages 200-201. Review of the iron and steel industry. Includes table of production of iron and steel for 1923-1933. MS (15a)

Depression Lifting for Ore Industry, *Steel,* Vol. 94, Feb. 12, 1934, pages 19, 42. Statistics of the Lake Superior Fe-ore industry for 1932-33. In 1933, shipments amounted to 21,672,410 gross tons. MS (15a)

Better Merchandising is Need in 1934. *Steel,* Vol. 94, Jan. 1, 1934, pages 93-95, 102. Discusses 1934 prospects in the following important steel consuming groups: railroads, canning, petroleum, and automobile industries; and building, construction, and public works. MS (15a)

Motor Cars Take Fifth of Steel Output. *Steel,* Vol. 94, Jan. 1, 1934, pages 96-98. Tabulates consumption ratios of main groups in the United States for 1922-1933, and distribution of various finished steel products in % and in gross tons to consuming groups for 1933. Latter are based on returns from 86 operating companies. Consumption of the 16,245,720 tons of finished rolled steel produced in 1933 was automotive, 20.95%; containers, 12.25%; buildings, 12.18%; railroads, 8.04%; oil, gas, water, 4.88%; machinery, 3.63%; exports, 3.61%; agriculture, 3.01%; and all other, 31.45%. MS (15a)

Alloy Steel Is Destined to Become Tonnage Product of Wide Use. *Steel,* Vol. 94, Jan. 1, 1934, pages 99-101. Reviews status of the alloy steel industry in the United States. Tabulates percentage of consumption by groups and by products for 1928-1933, and percentage of distribution of individual products to consuming groups in 1933. Consumption by groups in 1933 was automotive, 68.28%; machine tool, 3.57%; oil industry, 1.96%; agricultural, 2.07%; construction, 0.66%; exports, 0.29%; railroads, 0.92%; ship-building, 0.47%; and miscellaneous, 21.78%. MS (15a)

World Steel Production Is Up 31%, Pig Iron 23%. *Steel,* Vol. 94, Jan. 1, 1934, pages 117-118. Tabulates per capita production of pig-iron and steel ingots and castings in United States, 1880, 1890, 1900, 1910-1933; production of pig-iron and steel ingots and castings in the different countries of the world, 1913, 1925-1933; and exports and imports of the principal countries, 1913, 1930-1933. In 1933, production of steel and pig-iron respectively in gross tons was United States, 23,076,000 tons and 13,083,000 tons; Germany, 7,430,000 tons and 5,125,000 tons; Great Britain, 6,980,000 tons and 4,100,000 tons; Russia, 6,500,000 tons and 7,000,000 tons; France, 6,485,000 tons and 6,265,000 tons; Belgium, 2,655,000 tons and 2,705,000 tons; and Japan, 2,200,000 and 1,900,000 tons. World production was 65,281,000 tons steel and 48,083,000 tons pig-iron. MS (15a)

Belgium-Luxemburg Lead in Per Capita Use of Steel. *Steel,* Vol. 94, Jan. 1, 1934, pages 116-117. In 1933, average per capita consumption was Belgium-Luxemburg, 418 lbs.; United States, 410 lbs.; Great Britain, 302 lbs.; France, including the Saar, 301 lbs.; Germany, 233 lbs.; Russia, 107 lbs.; Italy, 94 lbs.; and Japan, 45 lbs. MS (15a)

Tax Spenders' Halcyon Days Pass; Ore Firms Let State Sue. A. J. Hain. *Steel,* Vol. 94, Jan. 1, 1934, pages 107-108. Reviews the tax situation of the iron ore mining companies in Minnesota. Cites evidences of extravagance in public buildings and payrolls in range communities, and examples of high taxes. In past 10 years, the mining companies' total tax bill has averaged more than $20,000,000 per year. Taxes paid to the state and local communities amount to 23% of the gross value of the ore at the mine. In 1933, taxes represented about 50% of the gross value of the ore shipped. Although containing only 3% of the state's population, the mining district pays 14% of all state and local property taxes. MS (15a)

Metal Mining in South Dakota, 1933—Advance Summary. Chas. W. Henderson. *United States Bureau of Mines Mineral Market Reports* No. M.M.S. 239, Jan. 9, 1934, 1 page. Au and Ag output in South Dakota in 1933 increased to 510,058 and 127,529 oz., resp. AHE (15a)

Gold, Silver, Copper and Lead in South Dakota and Wyoming (Detailed Statistics—Mine Report) Chas. W. Henderson. *United States Bureau of Mines, Statistical Appendix to Minerals Yearbook,* 1932-33, pages 31-37. **Gold, Silver, Copper, Lead and Zinc in Montana (Detailed Statistics—Mine Report)** T. H. Miller. *Ibid* 39-54. **Gold, Silver, Copper, Lead, and Zinc in New Mexico and Texas (Detailed Statistics—Mine Report)** Chas. W. Henderson. *Ibid* 77-90. **Gold, Silver, Copper, Lead, and Zinc in Utah (Detailed Statistics—Mine Report)** C. N. Gerry & Paul Luff. *Ibid* 91-102. **Gold, Silver, Copper, Lead, and Zinc in Idaho and Washington (Detailed Statistics—Mine Report)** C. N. Gerry & T. H. Miller. *Ibid* 117-139. **Gold, Silver, Copper, Lead and Zinc in Colorado (Detailed Statistics—Mine Report)** Chas. W. Henderson. *Ibid* 141-162. **Gold, Silver, Copper, Lead, and Zinc in Arizona (Detailed Statistics—Mine Report)** C. N. Gerry & T. H. Miller. *Ibid* 187-197. **Gold, Silver, Copper, Lead, and Zinc in California and Oregon (Detailed Statistics—Mine Report)** V. C. Heikes & Charles White Merrill. *Ibid* 199-224. **Ore Concentration (Detailed Statistics). Metallurgical Results and Flotation Reagents** T. H. Miller & R. L. Kidd. *Ibid* 225-238. **Gold, Silver, Copper, Lead, and Zinc in Nevada (Detailed Statistics—Mine Report)** V. C. Heikes & Charles White Merrill. *Ibid* 239-250. AHE (15a)

Tungsten Industry in 1933—Advance Summary. Frank L. Hess & H. W. Davis. *United States Bureau of Mines, Mineral Market Reports* No. M.M.S. 273, Apr. 20, 1934, 1 page. In 1933, 895 tons of concentrated W ore (reduced to an equivalent of 60% WO_3) was produced in the United States, as compared with 396 tons in 1932. AHE (15a)

Aluminum Industry in 1933—Advance Summary. H. W. Davis. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 262, Feb. 15, 1934, 3 pages. New Al produced in the U. S. during 1933 was 85,126,000 lbs., valued at $16,174,000 (104,885,000 lbs., $20,453,000 in 1932). World Al production exclusive of Russia declined 10% to 134,000 tons. Uses in 1933 are reviewed. AHE (15a)

Value of Mineral Products of the United States, 1930-1932, By States, Summary. M. B. Clark & E. T. Shuey. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 265, Mar. 9, 1934, 1 page. Tabular. AHE (15a)

The Empire and Copper. Wm. Cullen. *Industrial Chemist,* Vol. 10, Feb. 1934, pages 44-45. A brief survey of the economics and development of copper in the British Empire. RAW (15a)

The Aluminum Industry in Scotland. Geo. Boex. *Proceedings Institution of Mechanical Engineers,* Vol. 125, May 1933, pages 13-66. The aluminum industry in Scotland includes manufacture of alumina and carbon electrodes and the electrolytic production of the metal. Analyses of available raw material are given, processes and plants described at length; statistics of production are included. Ha (15a)

Five-Year Outlook for Steel. Robert E. Baker & Harold R. Moorhouse. *Iron Age,* Vol. 131, May 11, 1933, page 739. Taken from article in Jan. 1933 issue of *Harvard Business Review.* At times production may rise above 60%, as measured in present capacity, but it is unlikely that average output will exceed that figure in next 5 yrs. Manufacturers look forward to an increase in consumption in welded pipe of all sizes and for all purposes. Includes table to show advantages to steel industry accruing from water transport, or a combination of rail and water transportation over all rail haulage. VSP (15a)

Causes of Price Cutting in Foundries (Worauf sind die Preisunterbietungen mancher Giessereien zurückzuführen?) G. Krebs. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 55, Feb. 18, 1934, pages 72-74; Mar. 4, 1934, pages 89-91. Author considers at length determination of prices of castings, determination of working time per piece, accurate determination of sales prices, pattern costs, simple and rapid methods for determining production costs. Numerical examples are given. GN (15a)

The Use of Research in Industrial and Commercial Progress. Charles F. Kettering. *Year Book American Iron & Steel Institute,* 1933, pages 56-66. Research is promoted in a company (1) as a basis for advertising, (2) because the other fellow does it, (3) to solve a particular trouble and (4) to make an analysis of the industry and its problems and trends. (4) is the type of research industry must use in the future. Research will pay for itself if you will give it a four years' start. 40% of the research budget should be applied to work on the present product, 40% on advance problems and 20% on speculative future problems. VVK (15a)

The Economic Value of the Steel Industry to the United States. George H. Charls. *Yearbook American Iron & Steel Institute,* 1932, pages 115-125. See *Metals & Alloys,* Vol. 4, July 1933, page MA 228. VVK (15a)

British Steel Trade Now on the Upgrade. J. A. Horton. *Steel,* Vol. 94, Jan. 1, 1934, pages 163-164. Review of iron and steel trade in Great Britain in 1933. Includes statistics on average monthly production, imports, and exports for 1913, 1930—Oct. 1933. MS (15a)

Reactions of Steel against Competition of Reinforced Concrete (Les Réactions de l'Acier vis-à-vis de la Concurrence du Béton armé) A. De Marneffe. *Revue Universelle des Mines,* Series 8, Vol. 10, Mar. 1, 1934, pages 117-121; Mar. 15, 1934, pages 152-158. Principal points in favor of using reinforced concrete in place of steel structures are resistance against atmospheric influences and fire, and also its lesser sensitivity against bending stresses; the continuity of the whole structure reduces maximum values of stress. On the other hand, foundations are much heavier and costlier. Means to improve conditions for steel structures by using stainless steels, protective coats, etc., are discussed and new designs described where steel and reinforced concrete have been combined in a structure to make it more economical, lighter and fitted to conditions of load. Ha (15a)

Zinc Industry in 1933—Advance Summary. H. M. Meyer. *United States Bureau of Mines Mineral Market Reports* No. M. M. S. 267, Mar. 7, 1934, 3 pages. The production of distilled and electrolytic Zn in the U. S. in 1933 was 337,269 short tons, valued at $28,331,000 an increase of 52% in quantity and 113% in value over 1932. AHE (15a)

Rolled Zinc in 1933—Advance Summary. H. M. Meyer. *United States Bureau of Mines Mineral Market Reports,* No. M. M. S. 270, Apr. 19, 1934, 2 pages. The output of rolled Zn in the United States in 1933 was 41,261 tons, worth $6,055,000, an increase of 4% in quantity and 20% in value over 1932. AHE (15a)

Cadmium Industry in 1933—Advance Summary. H. M. Meyer. *United States Bureau of Mines Mineral Market Reports,* No. M. M. S. 276, Apr. 27, 1934, 1 page. Production of metallic Cd in the U. S. in 1933 was 2,276,933 lbs., an increase of 185% over 1932. Cd content of compounds was 401,400 lbs., 55% more than 1932. Imports were 108,861 lbs. AHE (15a)

French Steel Industry Meets Difficult Year Bravely. J. M. Leon. *Steel,* Vol. 94, Jan. 1, 1934, pages 169-170. Reviews conditions in the iron and steel industry during 1933. Includes statistics on average monthly production, imports, and exports for 1913, 1930—Oct. 1933. MS (15a)

Rare Metals. An Interesting Field Largely Neglected This Year. Donald M. Liddell. *Mining & Metallurgy,* Vol. 14, Jan. 1933, pages 43-45. Describes the progress made during the past year in the rare metals field. VSP (15a)

Restriction Schemes and Buffer Pools. E. H. Davenport. *Tin,* Feb. 1934, pages 1-4. Restriction of output, national as well as world restriction as an economic measure is discussed with particular application to Sn; it is shown that in this as in the case of tea conditions have been stabilized by it. Ha (15a)

The Metal Year 1933 (Das Metalljahr 1933) *Die Metallbörse,* Vol. 24, Jan. 3, 1934, page 4; Jan. 6, 1934, page 20; Jan. 10, 1934, page 36; Jan. 13, 1934, page 52; Jan. 17, 1934, pages 67-68; Jan. 20, 1934, page 24; Jan. 27, 1934, pages 116-117; Jan. 31, 1934, pages 132-133. As in previous years (See *Metals & Alloys,* Vol. 4, Mar. 1933, page MA 80) an economic-historical review of the most outstanding developments on the world's market in the metallurgical industries is presented under the following headings: general survey, Cu, Sn, Pb, Zn, scrap metals, semi-finished products. EF (15a)

The Metal Industries Under the National Recovery Administration. *Metal Industry,* N. Y., Vol. 32, Jan. 1934, page 1. The answer to an inquiry by Metal Industry regarding how rate of operation, employment, profit and prospects have been affected by the advent of N.R.A. PRK (15a)

Codes Effective for the Brass Foundries and the Ingot Makers. *Metal Industry,* N. Y., Vol. 32, Feb. 1934, pages 43-46. Abstracts of codes now in force for these two industries are given. PRK (15a)

Polish Iron Ore and Scrap. *Iron & Coal Trades Review,* Vol. 128, Mar. 2, 1934, page 372. Statistics of consumption, imports and exports since 1922. Ha (15a)

World Production and World Consumption of the Most Important Metals (Weltgewinnung und -verbrauch der wichtigsten Metalle) *Glückauf,* Vol. 70, Feb. 17, 1934, pages 159-162. Statistical data on Pb, Cu, Zn, Sn, Al, Ag, Au are compiled for the years 1929-1932 incl.; movement of prices is included. Ha (15a)

South Africa in 1933. *Mining Journal,* Special Review No., Vol. 184, Feb. 17, 1934, pages 26-28. **Canada in 1933.** Page 29. **British Columbia in 1933.** Page 30. **Gold Mining in Australia, 1933.** Pages 33-35. **New Zealand in 1933.** Page 36. **Nigeria in 1933.** Page 38. **Spain in 1933.** Page 40. **Portugal in 1933.** Page 40. **Norway in 1933.** Page 41. **Cornwall and Devon in 1933.** Page 41. **Tin Mining Industry of the F. M. S.** Pages 69-72. Reviews. AHE (15a)

Bismuth and Molybdenite in N.S.W. *Chemical Engineering & Mining Review,* Vol. 26, Jan. 5, 1934, page 160. Important sources of supply await development. Statistics on Bi and molybdenite production are tabulated. WHB (15a)

Progress of Magnesium Industry (Les progress de l'Industrie du magnesium) *Journal du Four Electrique,* Vol. 43, Feb. 1934, page 56. Generalities. JDG (15a)

Platinum and the Associated Metals. *Mining Journal, Annual Review No.,* Vol. 184, Feb. 17, 1934, page 12. World Pt production in 1933 was about 180,000 ozs. AHE (15a)

Silver in 1933. *Mining Journal, Annual Review No.,* Vol. 184, Feb. 17, 1934, page 4. Ag production and prices almost duplicated 1932; consumption was about 100,000,000 oz., 55,000,000 less than 1932. AHE (15a)

Steel Industry Faces Growing Scrap Scarcity. Lewis B. Lindemuth. *Iron Age,* Vol. 131, June 22, 1933, pages 988-990. Due to large amount of scrap that can be used in open-hearth the rapid expansion of industry to scale of operations of the 1920's would develop a definite shortage in scrap, because much of the steel of recent manufacture still is in useful service. Results of study are best shown by the 3 charts included. Chart I shows excess or shortage of plant scrap for Bessemer and open-hearth processes and for different proportions of product when both processes are used. Chart II shows % of total ingot production made by both processes for each year from 1886 and assumption of the future. Chart III shows tonnage each year and process by which made. Chart IV is the yearly need and available supply of scrap in terms of % of ingots produced. Chart V is a cumulative balance of total scrap available and total plant needs. VSP (15a)

Silver Yield from Copper Ores and the Effects of 64.64-cent Silver on the Value of Copper Ores Produced in the United States. Elmer W. Pehrson. *United States Bureau of Mines, Information Circular,* No. 6773, Mar. 1934, 15 pages. With normal demand for Cu, production from high-Ag districts will not be stimulated by the new Ag price to the point where stocks of Cu will be increased further. Production of by-product Ag from Cu ores will not be increased greatly. The geographic distribution of Cu production in the United States will not be altered materially. AHE (15a)

The Question of Manganese (La Question du Manganèse) L. Persoz. *La Technique Moderne,* Vol. 25, Mar. 1, 1933, pages 162-164. In first section, it is shown that Mn is quite indispensable in metallurgy where it is used (1) as desulphurizing element in production of cast Fe in blast furnace, (2) as deoxidizing element in steel manufacture, (3) as alloying element in some steels. Germany has tried out other products as a substitute such as Al and Si to Mn in deoxidization of steel but without success. Economically speaking it is then explained that steel producing countries do not process Mn ores. America, England, France and Germany represent 85% of world steel production whereas Russia, India, Gold Coast, Brazil and Egypt produce 85% of the world Mn production. FR (15a)

Germany Strives To Overcome Trade Crisis. E. H. Regensburger. *Steel,* Vol. 94, Jan. 1, 1934, pages 166, 168. Review of the iron and steel industry in 1933. Includes statistics on average monthly production, imports, and exports for 1913, 1930—Oct. 1933. MS (15a)

Steelmakers Adopt 4-High Mills To Win Broader Markets. J. D. Knox. *Steel,* Vol. 94, Jan. 1, 1934, pages 103-105. Survey of equipment expansion, replacement, and improvement in American iron and steel plants during 1933. There were 2 blast-furnaces dismantled, while 4 were remodeled and 2 are still being remodeled. Four open-hearth furnaces with a total annual capacity of 246,400 tons were completed. There were 20 rolling-mills completed and 10 building. MS (15a)

Readers' Comment

Elastic Lag in Creep Tests

To the Editor:

My own experience with creep effects, particularly at lower temperatures, indicates that a considerable portion of measured creep in high temperature tests is elastic lag rather than plastic flow, and that much of the creep disappears when the load is removed.

If creep is permanent, as assumed by most authorities, the fact can be readily checked by continuing creep measurements on a creep specimen after removing about 90% of the load. If creep is entirely plastic, no additional creep will be noted at this light load. If creep has an appreciable component of elastic lag, the removal of 90% of the load will set up a reverse creep in the opposite direction to the load creep, the specimen recovering much of its original extension.

Tests on cold worked bronze materials at normal temperatures show that the elastic lag increases rapidly as the temperature is increased, becoming large even at very light loads at a temperature just below the annealing point. Torsional pendulum specimens also show a large increase in internal friction or elastic lag when test temperatures are increased. In fact, elastic lag has been shown in several investigations to be an inherent property of metals, and the conditions of elevated temperature and extended periods of loading in creep tests are favorable for producing large elastic lag effects.

Consideration of high temperature creep effects as temporary will alter considerably the present interpretation of creep. Under loads in which the creep curve flattens out, creep failures could be prevented by periodic rest, and higher safe working loads or higher temperatures could be used than indicated by present creep investigations.

R. W. Carson,
Assistant Editor,
Product Engineering

June 1, 1934

Editor's Note:

This question, already raised by Mr. Carson in discussion* of a paper by McVetty, has, as was pointed out by others in that discussion, had some little attention. Tapsell and Prosser† carried out a creep test at 840°F. on a Ni-Cr-Mo steel at 22,500 lbs./in.^{2} for 1500 hrs., which gave a normal, positive creep rate, then reduced the load to 900 lbs./in.^{2} at the same temperature for another 1000 hrs., during which the specimen contracted—i.e., showed negative creep. That article does not show what would occur were the specimen again put under the initial load, but McVetty, in his reply to the discussion, cites a creep test he made on a medium-carbon steel at 750°F. and 25,000 lbs./in.^{2} for 850 hrs. The creep behavior was normal. The load was then decreased to 6,500 lbs., and for 48 hrs. the specimen contracted, in fact, twice as much as it had lengthened in the previous 48 hrs. under the higher load. After the low load had been on for 48 hrs., the original 25,000 lbs./in.^{2} load was reapplied and the specimen lengthened rapidly till it had made up for the contraction and from then on continued to creep just as it had under the original loading.

This would indicate that the negative creep or recovery would be canceled out in intermittent, repeated loading, by recurrence at each re-application of load of the more rapid, "first-stage" type of creep, rather than be subtracted from the total extension.

However, one isolated experiment is insufficient to establish this, and it is hoped that those who have observations on such experiments in their files will put them on record, and that those who are making creep tests right along make such experiments and report the results on a variety of materials, loads, and temperatures.—H. W. Gillett

**Mechanical Engineering,* June 1934, pages 362-367.

†H. J. Tapsell & L. E. Prosser. High-sensitivity creep-testing equipment at the National Physical Laboratory. *Engineering,* Feb. 23, 1934, pages 212-215.

The International Harvester Company has just completed the installation of a Lectromelt furnace at its tractor works, Cicero, Ill. The furnace has a capacity of 1000 lbs. per heat.

The Gilby Wire Company is now arranging to incorporate their business in France as a separate French company under the name of Gilby Wire Company Société Anonyme. Their French factory is located in Puteaux, near Paris.

MANUFACTURERS' LITERATURE

Fuess Instruments

The House of Rudolph Fuess has issued the following catalogs: Group A, Measuring Instruments for Air Pressure, Temperature and Humidity. Group B, Measuring Instruments for wind, rain and precipitation, evaporation, radiation and visibility. Group C, Instruments for the measurement of flow, pressure and vacuum for the control of heat. Group D, Microscopes and instruments for general optical observation and material testing. Group E, Spectroscopic Apparatus, Goniometers, Refractometers and special instruments for optical-crystal determination. R. Fuess, Inc., 245 West 55th Street, New York, N. Y. (220)

For Improving Gray Iron Castings

A leaflet suggesting the use of "Improvite" in gray iron castings for refined grain structure, improved machinability, increased resistance to wear, and greater resistance to corrosion. It is made to a definite composition, containing approximately 67% Ni, the balance consisting of graphitizing elements that cause cementite to decompose into graphite and pearlite. Kramer & Company, 21st & Loomis, Chicago, Ill. (221)

Electric Spot Welding the Taylor-Winfield Way!

Pamphlet illustrating and describing this method. Chart showing various methods of spot welding, also spot welding data. The Taylor-Winfield Corporation, Warren, Ohio. (222)

Nitralloy

Leaflet describing three groups of Nitralloy. It also discusses the special alloy steels classified as "Nitrard" which gives a core hardness of 500-650 Brinell and "Nitricastiron," their nitrided cast iron. List of applications for the alloys are given. The Nitralloy Corporation, 230 Park Avenue, New York, N. Y. (223)

"Operating Manual for Copper, Brass, Bronze and Zinc Plating with Copper Cyanide and Zinc Cyanide"

Operating manual for copper, brass, bronze and zinc plating with duPont copper and zinc cyanides. Presents information on the specifications and methods of using copper and zinc cyanides produced by duPont. Sections are devoted to instructions on making the plating solutions, operating, analyzing the solution and cleaning the metal prior to plating. Under the twenty-two divisions of the general subject there are such discussions as the advantages of using metal solutions, copper plating preparatory to localized hardening of steel, preparation of plating baths, formulas for solutions, methods of analysis and various others. Just off the press and prepared by the technical staff of the R & H Chemicals Department. E. I. duPont de Nemours & Company, Wilmington, Del. (224)

Metal Conveyor Belt Handbook

Just off the press very interesting and complete handbook which describes in detail conveying problems under abnormal conditions and how they may be handled. The necessity for quicker and less expensive methods for heat-treating and otherwise conditioning a wide variety of products—such as, washing, enameling and drying stamped metal parts; baking of foods, annealing glass; drying precipitates, and similar operations—has resulted in the perfection of a new and patented belt construction known as the Balanced Spiral, that greatly minimizes the problems previously encountered in conveying work under high temperatures, adverse atmospheric and abnormal load conditions, complete information concerning which is contained in this handbook. Wickwire Spencer Steel Company, 41 East 42nd Street, New York, N. Y. (225)

Type "CH" All Metal Cloth Screen Dust Collector

Bulletin No. 197, just off the press. This is one of the most complete catalogs published to describe and illustrate the many exclusive and new features not previously available in this class of equipment. Many large photographs, charts and drawings clearly illustrate the 14 outstanding points of superiority claimed for this new Collector. Pangborn Corporation, Hagerstown, Md. (226)

J-M Superex Blocks

Folder IN-20-A fully describes the recently announced new 1900 degree Superex Insulating Blocks. In addition to data on Superex, the folder discusses the principles of Combustion Insulation and shows how the careful selection of two or more insulating materials for use in a furnace or boiler wall not only assures more economical operation but in many cases results in lower construction costs. Tables of recommended thicknesses of Superex, both when used alone and in combination with other insulating materials are also included. Johns-Manville, 22 East 40th Street, New York, N. Y. (227)

Heat Enduring and Corrosion Resisting Materials

Complete data on this subject is brought together in a looseleaf binder containing bulletins and catalogs containing information on Calorized Pressed Steel Pots, Calorized Pyrometer Protection Tubes, Calorized Bolts and Nuts, The Selection of Material for Cracking Still Construction, Design and Use of Tube Supports in Cracking Stills, Radiant End Plates Increase Still Efficiency, Calite Alloy Steels, and a special report prepared by the Department of Engineering Research of the University of Michigan on the creep values of all Calite Alloys. The Calorizing Company, Wilkinsburg Station, Pittsburgh, Pa. (228)

Despatch Ovens

Bulletins and catalogs illustrating and describing Despatch Ovens for all purposes, with lists of accessory equipment and special equipment, specifications, etc., are contained in attractive looseleaf binder. Despatch Oven Company, 622 Ninth Street, S. E., Minneapolis, Minn. (229)

Forging by Baldt for Process and Power Uses

Chart of physical properties heat and corrosion resisting alloys. Information is offered in this chart for handy reference and general comparison, and has been collected chiefly from data supplied by various metal manufacturers. Baldt Anchor Chain and Forge Corp., Chester, Pa. (230)

Gilby Resistance Hand Book

This attractive handbook contains valuable information on nickel and its alloys in forms to meet the requirements of the electrical, radio, automotive, mechanical and chemical industries. Tables, charts, etc. 80 pages. Gilby Wire Company, Newark, N. Y. (231)

Simplified Magnetic Analysis

Leaflet illustrating and describing simplified portable apparatus for magnetic inspection, setting forth principles of the apparatus, advantages, and properties determined with the special apparatus Magnetic Analysis Corp., 42-44 Twelfth Street, Long Island City, N. Y. (232)

Duraloy

Brought together in a looseleaf binder are Bulletin No. 2013, "Duraloy for Resistance to Oxidation, Corrosion and Abrasion," Bulletin No. 3013, "Chromium and Chromium-Nickel Steels," Bulletin No. 3114, "Recuperators," Bulletin No. 279, "Duraloy, the Original Chrome Iron in the Mining Industry for Resistance to Corrosion by Acid Mine Water and to Abrasion," Bulletin No. 2710, "Duraloy, the Original Chrome Iron All-Metal Baffles for Steam Boilers, Oil Stills and the Like." All bulletins are profusely illustrated and contain much valuable data on the subjects mentioned. Tables, charts, graphs, etc. The Duraloy Company, Pittsburgh, Pa. (233)

Cold Drawn Squares and Flats

Leaflet illustrating and describing Union cold drawn steels. Tables and much useful information. Union Drawn Steel Company, Massillon, Ohio. (234)

Exact—Instant—Dependable Control of Oil At All Times

Leaflet illustrating and describing Hauck Micro Regulating Valves. Tables of sizes and capacities. Hauck Manufacturing Company, 126-134 Tenth Street, Brooklyn, N. Y. (235)

Zeiss Large Metallographic Microscope

Booklet illustrating and describing this microscope. Tables. Carl Zeiss, Inc., 485 Fifth Avenue, New York. (236)

Seymour for Service

Useful and valuable data on Nickel Silver, Sheets, Rolls, Wire, and Rods, Phosphor Bronze and Brass and Commercial Bronze is brought together in an attractive pocket size loose-leaf binder, recently from the press. The Seymour Manufacturing Co., Seymour, Conn. (237)

Aerocase for Case Hardening and Heat Treating Steel

Booklet containing interesting data on the use of Aerocase compounds for case hardening and heat treating steel in a liquid bath. American Cyanamid and Chemical Corporation, 30 Rockefeller Plaza, New York, N. Y. (238)

Ironton Fire Brick

Leaflet illustrating and describing this type of fire brick. Tables of analysis. The Ironton Fire Brick Company, Ironton, Ohio. (239)

X-Ray and the Foundry

Interesting treatise on this subject setting forth how the X-Ray has now come to the fore as a tool of the testing laboratory. Radiograph illustrations. The Kelley-Koett Mfg. Co., Inc., Covington, Ky. (240)

Steel Treating Instrument Data Book

An illustrated review of current methods. Booklet in which a variety of steel treating jobs are pictured. The problem in each case is described. The respective heat treating methods generally, with the temperature limits involved, are outlined. The type of furnace equipment commonly employed is indicated. The character of the instrument equipment preferable for the work is suggested. The Brown Instrument Company, Wayne and Roberts Avenues, Philadelphia, Pa. (241)

Republic Galvanized Sheets

Illustrated folder showing the various uses of these galvanized sheets. Photomicrographs, tables of maximum widths and lengths of sheets, etc. Republic Steel Corporation, Youngstown, Ohio. (242)

Fultaloy Metal

Interesting leaflet, profusely illustrated showing typical applications of Fultaloy Metal, table of physical properties. Fulton Iron Works, St. Louis, Mo. (243)

Lukens Cromansil Steel

Much interesting data is set forth in a leaflet on this subject. Tables of comparison, physical properties. Illustrations. Fabrication and shop use. Lukens Steel Company, Coatesville, Pa. (244)

The Progress of Bronze-Welding

Booklet setting forth the correct practice for this application and its advantages in joining the more common metals. Illustrated. The Linde Air Products Company, 30 East 42nd Street, New York, N. Y. (245)

Soffel's Cupola and Ladle Flux in Cupola Practice

This interesting booklet containing valuable information on this subject has been published in the interest of the iron founders by Pittsburgh Metals Purifying Corp., P. O. Box 31, N. S., Pittsburgh, Pa. (246)

Crucibles

Booklet furnishing sizes and capacities of McCullough-Dalzell crucibles for brass melting, enabling the buyer to select the size suitable to his furnace or of the capacity for his requirements. McCullough-Dalzell Crucible Company, Pittsburgh, Pa. (247)

Firth-Sterling Products

Leaflet describing tool and alloy steels, stainless steels, sintered carbides manufactured by Firth-Sterling Steel Company, McKeesport, Pa. (248)

Sperry Rail Detector Cars

Bulletin No. 57 is an interesting booklet setting forth how the menace of broken rails can now be ended. Illustrations. Graphs. Sperry Products, Inc., Sperry Bldg., Manhattan Plaza, Brooklyn, N. Y. (249)

Working Data and Technical Facts on Carpenter Stainless Steels

Booklet containing a great amount of specific information on the subject of stainless steel. A special effort has been made to arrange and tabulate the information in a form that will be most usable to those who want to know where stainless steel can be economically and satisfactorily used, what grade of stainless to select, and how to handle it with the greatest ease after it has been procured. The Carpenter Steel Co., Reading, Pa. (250)

Bluehead Electric Furnaces for the Laboratory

Catalog No. 34 illustrates and describes this apparatus. Specifications. Cooley Electric Furnace Co., Indianapolis, Ind. (251)

Thermalloy High Temperature Equipment

Booklet containing a simple story of material, facilities and service. Illustrated. The Electro Alloys Co., Elyria, Ohio. (252)

Lithorizing

Leaflet setting forth this process for making paint hold to galvanized iron. American Chemical Paint Co., Ambler, Pa. (253)

Aluminum Alloy Castings

Treatise on this subject containing much valuable information. Standard Aluminum Casting Alloys from Society of Automotive Engineers Specifications and from British Engineering Standards Association's Specifications, from American Society for Testing Materials Specifications, from U. S. Navy Specifications. The British Aluminium Co., Ltd., 30 Rockefeller Plaza, New York, N. Y. (254)

Kipp Air Tools

Catalog AT-2020 contains general information on these tools. Illustrations, classification chart, general operating instructions, cross sectional views. Madison-Kipp Corporation, Madison, Wis. (255)

Sentry Furnaces

Bulletin No. 1011, "Sentry Furnace, Model L, Industrial Pot Furnaces for Heat Treating in Lead, Salt and Cyanide or Melting Soft Metals" gives full information on this type of furnace for accurate, dependable and effective heat treatment. Specifications. The Sentry Company, Foxboro, Mass. (256)

(Published by the same firm: Bulletin No. 1012-2 "The Sentry Diamond Block Method of Hardening High Speed Steel," Bulletin No. 1008-2, "Sentry Furnaces Model HS, Industrial Electric Furnaces for High Temperatures," Bulletin No. 1010, "Sentry Furnaces, Standard Model H, Industrial Electric Furnaces for Hardening Carbon Steel, Annealing, Enameling, Preheating and Drawing, High Speed Steel," Bulletin No. 1016, "Sentry High Temperature Tube Furnace," Bulletin No. 1018, "Sentry Electric Furnace for Hardening High Speed Steel.")

Mathieson Industrial Chemicals

A series of interesting bulletins on this subject have been prepared as follows: Bulletin No. 285, "Refining Iron with Purite," Bulletin No. 286, "Purite in Malleable," Bulletin No. 287, "Desulphurizing with Purite," Bulletin No. 305, "Fluxing with Purite," Bulletin No. 308, "Purite in Non-Ferrous Metallurgy." All illustrated and containing diagrams of installations, plan views, sectional views, tables. The Mathieson Alkali Works, Inc., 250 Park Avenue, New York, N. Y. (257)

Tombasil

Booklet telling the story of this alloy for sand castings, chill and pressure castings and bells. Tables, sections, tables of tensile properties of Tombasil, chart showing curves. The Ajax Metal Company, Philadelphia, Pa. (258)

(Published by the same firm: "Ajax Fluxing Alloys," "Two Famous Alloys," "Stands for Service," "Babbitt Facts," "Its Up to Ajax for Service and Performance.")

Ing-O-Clad

Leaflet describing this mild carbon steel clad with stainless. Ing-O-Clad combines the non-corrosive service of stainless steel with the economy of mild carbon steel and multiplies the possibilities for the use of stainless steel in all industries. Ingersoll Steel & Disc Co. (a Division of Borg-Warner Corp.), 310 South Michigan Avenue, Chicago, Ill. (259)

Houghton on Quenching

A treatise on the quenching of steel containing chapters on what happens when steel is heated and cooled, factors affecting cooling speed, water and brine solutions as quenching media, quenching oils, Houghton's No. 2 Soluble Quenching Oil, cooling systems and oil circulation, has been prepared by the Research Staff of E. F. Houghton & Co., Philadelphia, Pa. (260)

Ampco Metal

Catalog No. 20 is brimful of interesting data on Ampco Metal, its uses in modern industry. Profusely illustrated. Centrifugal casting dimension range, table of bushing weights, etc. Ampco Metal, Inc., Milwaukee, Wis. (261)

The Story of Corhart Electrocast

Handsome brochure. Profusely illustrated. Data, shapes, weights. Chart of thermal expansion curve. Corhart Refractories Co., Inc., 16th & Lee Streets, Louisville, Ky. (262)

An Innovation in Pyrometry

Leaflet describing the New K & S Pyrometer. Simple to use, can be used by any workman. Most compact and accurate and very low in cost. The Industrial Pyrometer Company, Post Office Box 175, Painesville, Ohio. (263)

(Published by the same firm, Leaflet describing the K & S Aestometer, a radiation type indicating optical pyrometer.)

Page Welding Wire and Electrodes

Booklet describing various grades of Page welding rods. Typical chemical analysis and much useful information. Page Steel and Wire Division of American Chain Co., Inc., Monessen, Pa. (264)

Buy It "By the Foot"

Leaflet containing data on Permite Aluminum Paint and its uses. Aluminum Industries, Inc., Cincinnati, Ohio. (265)

Fluxine

A series of leaflets containing data on Fluxine Brazing and Welding Compounds, used by the largest fabricators of metals for perfect results with economy. Krembs & Co., 669 W. Ohio St., Chicago, Ill. (266)

Hayes Certain Curtain Electric Furnaces

Bulletin No. 102 illustrates and describes type HG for hardening alloy and high speed steels, range 1850° to 2500°F. Bulletin No. 202 illustrates and describes type LR for preheating high speed steel and heat treating carbon, alloy, and stainless steels, range 1200° to 1850°F.; Furnace specifications and table of sizes and ratings. C. I. Hayes, Inc., 129 Baker Street, Providence, R. I. (267)

P. B. Sillimanite Super Refractories

Booklet setting forth valuable information on the subject of P. B. Sillimanite, its properties, uses, chemical composition. Electrical resistance chart, etc. The Chas. Taylor Sons Co., Cincinnati, Ohio. (268)

Phosphor Bronze

Booklet giving full information regarding this alloy, "Phosphor" Bronze, which is a true bronze of copper and tin with the addition of phosphorus, and, in the case of bearing metal, of lead as an anti-friction ingredient. The Phosphor-Bronze Smelting Co., 2200 Washington Ave., Philadelphia, Pa. (269)

Luxitize Your Cupola

Leaflet setting forth this modern method for laying bricks in cupolas, for patching, for coke or coal fired brass furnaces, to line gas or oil fired crucible furnaces with Luxit. The Alpha-Lux Company, Inc., 192 Front St., New York, N. Y. (270)

Spanning the Many Gradations of Exacting Industrial Needs

Leaflet setting forth the dynamic strength and relentless wear-resistance properties of Machempite, the special alloy steel and Iralite, the special alloy iron. Mackintosh-Hemphill Co., Pittsburgh, Pa. (271)

Botrefco Adahearth

Leaflet describing this plastic Chrome Ore Refractory for constructing monolithic hearths, furnace linings and special shapes. Botfield Refractories Co. Swanson and Clymer Streets, Philadelphia, Pa. (272)

(Published by the same firm, "Adamant Fire Brick Cement," "Adachrome Plastic Super Cement," "Zirconite, a Refractory Cement in Dry Form," "Adapatch, the Plastic Patching Material that Lengthens the Life of Fire Brick Construction," "Adaset Fire Brick Cement.")

Lincoln "Linc-Weld" Self-Protecting Motors

Leaflet illustrating and describing these self-protecting motors setting forth construction features, methods of operation, tables of dimensions, notes, tolerances, and cycle ratings. The Lincoln Electric Company, Cleveland, Ohio. (273)

Cold Work as a Substitute for Heat Treatment

Leaflet containing facts that will lead many manufacturers to new economies by the use of Union cold drawn steels in developing such well known qualities as bright finish, accuracy and straightness. Union Drawn Steel Co., Massillon, Ohio. (274)

L & N Automatic Furnace Pressure Control

Bulletin No. 842-L, just off the press, describes and illustrates fully this new automatic furnace pressure control. Diagrams, installation data, equipment specifications, mounting dimension diagrams. Leeds & Northrup Co., 4901 Stenton Avenue, Philadelphia, Pa. (275)

The Integral-Furnace Boiler

Bulletin G-17 (1934) contains complete information regarding this boiler. Illustrations, sectional drawings, details. The Babcock & Wilcox Co., 85 Liberty Street, New York, N. Y. (276)

Electric Melting with the Detroit Rocking Electric Furnace

Attractive booklet setting forth the uses and advantages of this rocking furnace. Illustrations, operating procedure, applications, tables, actual operating cost data. Detroit Electric Furnace Company, Detroit, Mich. (277)

Coleman Core and Mold Ovens

Catalog "F" sets forth complete data on this type of foundry ovens and furnaces. Illustrations, charts. The Foundry Equipment Co., Cleveland, Ohio. (278)

A New Era in Electric Melting

Reprint from *The Foundry* on the development of the Gibney-McLain Electric Furnace for Super-refined carbon and alloyed steel castings, electric semi-steel using 30 to 50% steel, no pig iron, electric high test gray iron using all scrap, no pig iron, nickel, chromium and other alloyed high carbon metal. McLain's System, Inc., 803 Goldsmith Bldg., Milwaukee, Wisconsin. (279)

Induction Drying Ovens

Bulletin describing the Ajax-Northrup principle of induction heating available in paint, enamel and lacquer drying ovens. Photographs of actual induction oven installation at the Chrysler and Plymouth plants. Ajax Electrothermic Corp., Ajax Park, Trenton, N. J. (280)

Electric Furnaces for Bright Annealing

Bulletin No. 301 just issued discusses three classes of furnaces for bright annealing: Type MA suitable for annealing small stampings at temperatures to 1600°F. continuous or 1850°F. intermittent, Type LA for average production sizes up to 1850°F. continuous or 2000°F. intermittent, and Type HA for annealing precious metals and stainless iron and steel for any temperature up to 2400°F. continuous. C. I. Hayes, Inc., 129 Baker St., Providence, R. I. (281)

Sandvik Steels

Attractive booklet containing much interesting data on Sandvik Steels for construction of aircraft. Illustrations, charts, tables of sizes and lengths, tensile strengths, standard specifications. Sandvik Steel, Inc., 233 Broadway, New York, N. Y. (282)

Alloy Hy-Ten Steels

Data sheets, special analyses of Whelco tool steels, standard S.A.E. grades, Economo Alloy Steels. Wheelock, Lovejoy & Co., Inc., Cambridge, Mass. (283)

Illium-G

Leaflets setting forth data on this product which is strong, tough and hard and possesses these qualities in proportions that fit it excellently for a wide variety of uses. Illustrated. Burgess-Parr Co., Moline, Ill. (284)

Oil Field Welding

Booklet the purpose of which is to tell the welder how to reclaim drilling tools and how to apply hard-surfacing metals and Borium. Very interesting and valuable book for the welder. Stoody Company, Whittier, Calif. (285)

Cambridge Thermo-Electric Pyrometers

List No. 194 is an attractive booklet on the subject of Cambridge Thermo-Electric Pyrometers for indicating and recording temperatures to 1400°C. (2552°F.). Contains data on indicators, recorders, thermo-couples, cold junction control, methods of mounting thermo-couples, typical wiring diagrams, etc. Cambridge Instrument Co., Inc., 3512 Grand Central Terminal, New York, N. Y. (286)

Liquid Fuel Equipment for Stationary, Marine and Locomotive Boilers

Booklet containing data on the W. N. Best complete line of oil burning equipment and installation of same. Illustrations. Table of typical calorific values of fuels, diagrams, etc. W. N. Best Corp., 39 Cortlandt St., New York, N. Y. (287)

Phosphor Bronze Bushings

A stock list showing over 600 sizes of general purpose bushings has been prepared in most convenient form, the items being arranged according to diameter. The large type makes it particularly easy to read. Bulletin No. 339-A. Johnson Bronze Company, New Castle, Pa. (288)

Refractories

A 70-page book on the subject of refractories shows typical installations, using both standard and special shapes and includes much useful data on figuring quantities of material needed. Some space is devoted to the use of "Latite" as a bonding mortar. Well illustrated. Catalog No. 145. Denver Fire Clay Company, Denver, Colo. (289)

Free Cutting High Manganese Screw Stock

Pamphlet devoted to "Rycase," a moderate-priced production steel which will develop a strong, hard case with a tough core and will machine as easily as Bessemer screw stock. Gives its chemical composition and physical properties. Results of two case studies are given comparing "Rycase" to S.A.E. 1020 and S.A.E. 1120. Joseph T. Ryerson & Son, Inc., 2558 West 16th St., Chicago, Ill. (290)

Dust Collecting Equipment

The following leaflets may be obtained: Bulletin 189, Sand Blast Pressure and Suction Machines; Bulletin 184, Type EA-1 Suction Feed Blast Cleaning Cabinet; Bulletin 194, Type "GF" Barrel Blast Cleaning Machines; Bulletin 151, Type "LB-1" Table Sand-Blast; Bulletin 187, Sand Blast Rooms; Bulletin 176, Type "BVR-5" Blast Abrasive Separator. Pangborn Corporation, Hagerstown, Md. (291)

Midvale Stainless

Booklet gives the characteristics of stainless steels, and includes a table showing the behavior of stainless iron and stainless steel in contact with various substances. A list of possible applications is given. The Midvale Company, Nicetown, Philadelphia, Pa. (292)

Mayari Pig Iron

Fabrikoid bound, 100-page booklet discusses distinctive features of Mayari pig iron and advocates its use in making high-grade castings. Booklet includes two articles on this subject by the late Dr. Richard Moldenke, giving results of tests conducted by him. Of special interest and value to all foundrymen. Bethlehem Steel Company, Bethlehem, Pa. (293)

Haynes Stellite

Attractive pamphlet gives chemical and physical properties of Haynes Stellite. Haynes Stellite cutting tools have had remarkable success in many types of machining operation. By a slightly modified welding process a coating of Haynes Stellite may be applied to a steel or iron base as a protection against wear. Haynes Stellite Co., Kokomo, Indiana. (294)

Vascoloy-Ramet

32-page booklet devoted to Vascoloy-Ramet, a superior hard cutting material, tantalum carbide, for tools and dies. Illustrated. Instructions are given for use of Vascoloy-Ramet tools. Includes price list and specifications for Vascoloy-Ramet dies. Vanadium-Alloys Steel Co., Pittsburgh, Pa. (295)

Welding Wrought Iron

Complete instructions for welding wrought iron are given in this leaflet, together with physical properties of this material. It is pointed out that where wrought iron pipe is used the welding fittings should also be of wrought iron. A. M. Byers, Pittsburgh, Pa. (296)

Open Hearth and Rail Carbon Steel

286-page, fabrikoid-bound catalog giving shapes and sizes in which open hearth steel and rail carbon steel may be obtained. Many useful conversion tables. Gives manufacturers' standard specifications for structural steel. Inland Steel Company, First National Bank Bldg., Chicago, Ill. (297)

Firebrick Cement

Pamphlet discussing "Dura-Stix," a refractory bonding mortar for maintaining furnace walls, arches and baffles in boiler furnaces. Gives directions for its use. Keystone Refractories Company, Inc., 120 Liberty St., New York, N. Y. (298)

Reference Book of Steel Treating Tabulations

Extremely useful data book. Includes tables showing high speed steel weights, carbon and alloy steel weights, wire gages, S.A.E. steel specifications, grinding wheel selection, etc. Ludlum Steel Company, Watervliet, N. Y. (299)

Mo-Lyb-Die Products and Forgings

Loose-leaf catalog of molybdenum chromium nickel products developed under trade name of "Mo-Lyb-Die" products. Gives specifications for die blocks in various grades. Some space devoted to "Durodi" steel for hot work, giving its heat treatment and applications. Mention is made of "Mo-Cro-Ni" trimmer steel. A. Finkl & Sons Co., Chicago, Ill. (300)

Oven Furnaces

Oven furnaces, principally used for hardening and annealing, are described. Gives cross section diagrams and illustrations. Describes automatic heat controller. Price list. Bulletin No. 2D. American Gas Furnace Company, Elizabeth, N. J. (301)

Stainless Steel Alloys

Pamphlet containing helpful information about Armco stainless steel sheets, plates and strip. Gives heat treatment and fabrication of Armco 18-8 and Armco 17. American Rolling Mill Company, Middletown, Ohio. (302)

Industrial Alloy Steels

Compact little catalog discusses in detail properties and applications of Carpenter industrial alloy steels. New uses for these steels are in light construction in machine tools, electrical apparatus, railway appliances, and particularly in the aeronautical industry. Catalog No. 10. Carpenter Steel Co., Reading, Pa. (303)

Pickling Machines

Machines for pickling sheets, tin plate, drop forgings, stampings, pipe, automobile parts, alloy forgings, small castings, etc., are described. Operation of machines is given. Illustrated. Bulletin "M." Mesta Machine Co., Pittsburgh, Pa. (304)

Rust Proofing Process

Attractive pamphlet describing "Parkerizing," the Parker process of rust proofing. Process is adaptable to needs of large or small manufacturer. Bulletin is profusely illustrated. Parker Rust-Proof Co., Detroit, Michigan. (305)

Electric Heat Treating Furnaces

Illustrations and brief descriptions of all types of electric heat treating furnaces are given. Includes carbonizing furnaces, pusher furnaces, conveyor furnaces, annealing furnaces, in various sizes and styles. Holcroft & Co., 6545 Epworth Blvd., Detroit, Mich. (306)

Steel and Wire Products

By an arrangement with the Allegheny Steel Company the Page Steel and Wire Company will supply wire rolled and drawn from the various stainless steels and alloys produced by them. Bulletin lists some of the wire products now available in Page-Allegheny alloys. Page Steel & Wire Company, Monessen, Pa. (307)

Lukenweld Construction

Arc-welded steel construction, Lukenweld construction gives new freedom in engineering and design. Permits use of various analyses of steels in different members of machinery parts, and patterns, cores and molds are not limiting factors. Bulletin No. 2. Illustrated. Lukenweld, Inc., Coatesville, Pa. (308)

Insulating Firebrick

Bulletin R-2-C describes B & W insulating firebrick, giving their load carrying characteristics, insulating properties and applications. Diagrams and sketches. Babcock & Wilcox Co., 85 Liberty St., New York, N. Y. (309)

Carboloy Standard and Special Tools

Catalog M32-R gives specifications for standard and special tools. Illustrated. Price list included. Carboloy Company, Inc., Detroit, Michigan. (310)

Open Hearth Charging Machines

Bulletin No. 94 gives constructional details of open hearth charging machines. Diagrams and illustrations. Wellman Engineering Company, Cleveland, Ohio. (311)

METALS & ALLOYS, 330 West 42nd St., New York, N. Y.

I should like a copy of each piece of Manufacturers' Literature listed below.

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Name____________________________________

Position__________________**Firm**__________________

Street and Number____________________________

City__________________**State**__________________

NEW EQUIPMENT and MATERIALS

Six New Carboloy Grades

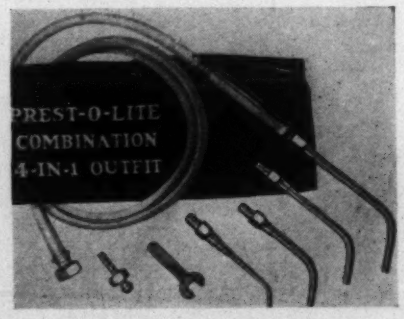
Carboloy Company, Inc., Detroit, Mich., announces the release of 6 new grades of Carboloy cemented carbide. These supplement the 6 existing grades and have been developed primarily to obtain improved performance in special fields of application. Among these applications are the rough and finish boring, finish turning and facing of steel brake drums, single-point finish boring of steel connecting rods, re-boring automotive cylinders, and turning-facing-boring piston rings. The 6 new grades are designated as 715, 831, 883, 905, 906, 907.

New Coated Welding Electrodes for High Carbon and High Strength Steels

Difficulty in arc welding steels containing more than .20% C is overcome by a new heavy coated electrode, known as "Murex Special A," it is announced by the Metal & Thermit Corporation, New York City. The new electrode, an improvement of a previous design, hinders the migration of carbon from the parent metal to the deposited metal when welding and assures a more ductile deposit. Sound, dense, X-ray-clean welds, having excellent penetration, can be made in high carbon steels with perfect ease with this new addition to the Murex line it is claimed. The deposit, containing a small quantity of nickel, has unusually good physical properties and stress-relieved, all weld metal specimens invariably show clean full-cupped fractures under test. The tensile strength of these deposits is 73,000 lbs./in.^{2}, the yield point 59,000 lbs./in.^{2}, the elongation in 2 inches is 31%, and the reduction in area is 63.5%. Other recently developed Murex electrodes, designed for use with the latest high strength steels now make it possible to obtain welds with tensile strengths of 85,000 to 100,000 lbs./in.^{2}. Such high strengths are obtained by including Ni or Mo, or a combination of these elements in the deposited metal. For example, one of the new electrodes, depositing 2½% Ni, is being used extensively in the welding of steels of this same analysis for low temperature work where welds must show Charpy impact resistance of 10 to 24 ft.-lbs. at the extremely low temperature of —75°F. The physical properties of this weld metal are also, it is said, extraordinary. Tensile strengths average 86,000 and yield points 72,000 lbs./in.^{2} The elongation in 2 inches is 25.5%. The reduction in area is 64%.

New Prest-O-Lite Combination Outfits

The Linde Air Products Company, New York, N. Y., recently announced important additions to its line of equipment for soldering, brazing and heating. These new outfits are the Prest-O-Lite 4-in-1 Outfit, and the Prest-O-Lite Plumber's Outfits. The new 4-in-1 Outfit was assembled and is presented to the trade for the benefit of those who found the 5-in-1 Outfit more comprehensive than necessary for the particular line of work in which they were engaged. It differs from the 5-in-1 Outfit in that 4 stems instead of 5 (the soldering iron is omitted), and a durable, waterproof fabric carrying case, instead of the heavier metal case, are offered at a somewhat lower price consistent with the difference in equipment. The 4 stems cover: fine soldering such as that used by jewelers, toy manufacturers, telephone repairmen, and for exact heating operations on delicate instruments; light soldering, brazing and heating, as for making soldered wire splices, and for auto, truck and tractor radiator work; medium soldering, brazing and heating, ideal equipment for sealing batteries, burning cable lugs and for all average open flame work; and heavy soldering, where the torch must furnish a large volume of heat sufficient for bending rod, straightening dented fenders and other automotive repair work. Two Plumber's Outfits for soldering copper piping installations are available. The No. 1 Plumber's Outfit consists of a Prest-O-Lite torch with a needle valve, 15 ft. of hose and a 5-lb. pressure regulator. A mixer in the torch stem maintains exactly the right proportions of acetylene and air, thus insuring maximum flame intensity. The needle valve, which permits the gas to be turned on and off at the torch handle, adds to the convenience of the outfit. The pressure regulator holds the gas at uniform working pressure which insures economical gas consumption. The No. 2 Plumber's Outfit consists of a Prest-O-Lite torch and extra stem, 15 ft. of hose and a tank union.

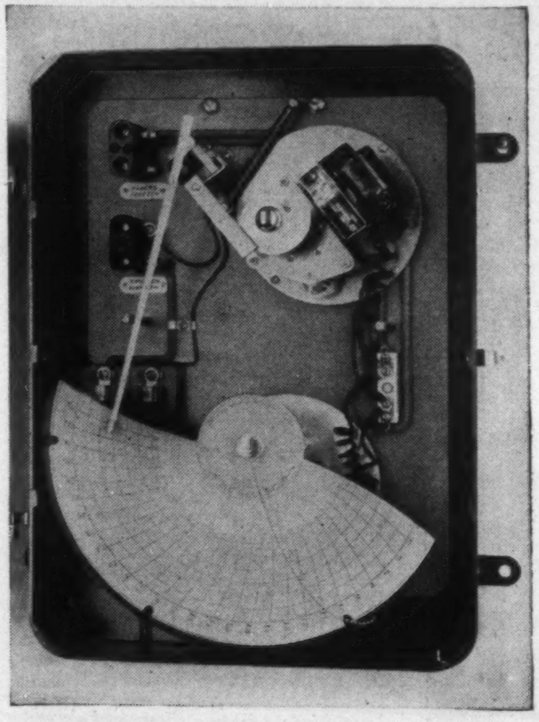


Improved Valve for Oxweld Blowpipe

A new type of needle valve—the ball-seat needle valve—is now being supplied on most Oxweld blowpipes of The Linde Air Products Company, New York, N. Y. The new type valve consists of a seat between the blowpipe body and the needle valve which is made of a hardened and highly polished stainless steel ball, held in a cage at the end of the valve stem. Tests have shown this type of seat to have sealing properties that are strikingly superior to other designs. This type valve closes readily with but the slightest effort of two fingers and opens with equal readiness. The polished ball frees itself readily of all foreign particles that might impair the gas-tight seat. Consequently, blowpipes using these valves will need less maintenance work than ever before.

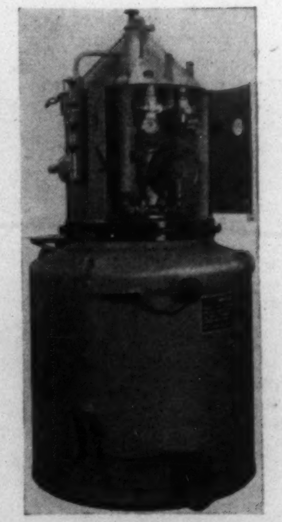
Spiral-record Cam-operated Electrical Operation Recorder

The Bristol Company, Waterbury, Connecticut, is now offering an electrical operation recorder, which provides a long record on a fast moving round chart. This instrument, instead of making one circular record, draws a spiral curve starting at the outer edge of the chart and gradually moving toward the center. This spiral record is accomplished by a telechron cam which continuously resets the record making movement. This instrument can be used in time study work since it provides an open record with the easy filing and ready reference characteristics of the round chart. One form of this instrument is fitted with a chart driving clock, making one revolution per hour and with a separate telechron motor driven cam making one revolution in 8 hours. The resulting record is a spiral curve covering 8 rotations of the chart and with approximate ¼" spacing of the record line. The mechanism which records the occurrence of an operation is a small electro-magnet which is energized when an external circuit is closed. The movement of this magnet actuates the pen arm and moves the inking pen approximately $\frac{1}{16}$".



New Portable Oxweld Generator

The Linde Air Products Company, New York, N. Y., has just announced a new Oxweld generator, Type MP-4 Portable Acetylene Generator. It is intended for portable service only, and is specially designed to withstand the abuse encountered in such service, particularly in overland pipe construction. The capacity of this new generator is 150 lbs. of ¼"x$\frac{1}{12}$" (quarter size) carbide. The generator is listed as standard by the Underwriters' Laboratories, Inc. It is rated to produce 300 cu. ft. of acetylene per hr. It weighs 750 lbs. empty, is 87" over-all in height, and 42¾" in diameter. Fully charged the generator weighs 2,250 lbs. The feed is of the gravity type. The feed control unit is self-contained and is bolted to the inside of the carbide hopper. The feed valve unit is actuated by a diaphragm. Pressure on the diaphragm is exerted by a housed and loaded spring unit. The spring is encased in a small housing and set at the factory to deliver about 13 lbs./in.^{2} pressure. This can be changed within a range of about 2 lbs./in.^{2} by an external adjustment. The set pressure feature does away with the necessity of setting the pressure when the machine is started. At all rates of generation, the pressure variation within the generator is not more than ¾ lbs./in.^{2}. This slight variation is removed by means of a new type of regulator designed for this particular job. This regulator, Oxweld Type R-56, is a large unit built into the generator in a novel and ingenious manner.



2400°F. Metallic Wound Furnaces

The Harold E. Trent Company, Philadelphia, Pa., is producing furnaces with metallic ribbon for temperatures up to 2450°F. The furnace illustrated was designed for checking thermocouples, and has a long area of even heat. The standard Laboratory and Box Type Furnaces for temperatures up to 1850°F. have been modified and can now be obtained for temperatures up to 2400°F. They can also be provided with piping for hydrogen atmosphere. Furnaces of special design with high, even temperatures are, therefore, now available for metallurgical laboratory research.

Alundum Rubber Bonded Safety Treads

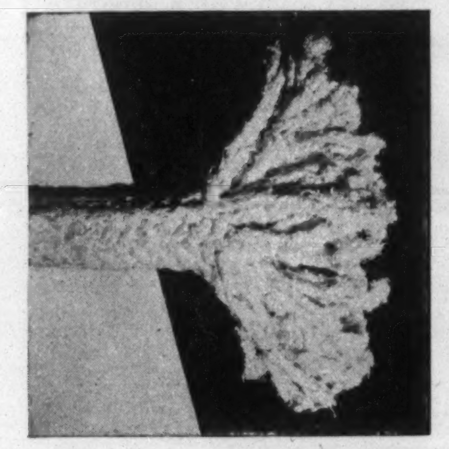
An entirely new type of safety tread that is especially suitable for use in industrial plants and factories as well as in office buildings, schools, stores and similar places, has just been placed on the market by Norton Company of Worcester, Massachusetts.

Designated as the Alundum Rubber Bonded Safety Tread the new Norton Floors product is composed of Alundum Aggregate securely bonded in a reinforced base of hard, tough rubber. The Aggregate is used to provide non-slip effectiveness rather than plain abrasive grain because the latter has a hard, smooth glassy surface that does not provide sufficient bonding ability to withstand the severe service to which a floor material is subjected. Aluminum Aggregate is produced by taking fine sizes of Alundum abrasive (aluminum oxide) and mixing it with special bonding clays. The mixture is pressed into blocks and is vitrified in kilns. The blocks are then crushed and screened to the desired sizes. The resulting aggregate consists of the minute grains of abrasive held together by the hard, glass-like vitreous bond. The aggregate is irregular, angular and slightly porous so that it bonds perfectly and securely with the rubber.

Alundum Rubber Bonded Safety Treads have a surface that is highly non-slip—even at the very nosing edge. This is an important feature for it is at the nosing that the foot pivots when one is descending a stairway. The tread's non-slip effectiveness is permanent—it will not wear smooth. It has a flat, level surface so that there is nothing to catch heels or to cause a tripping hazard.

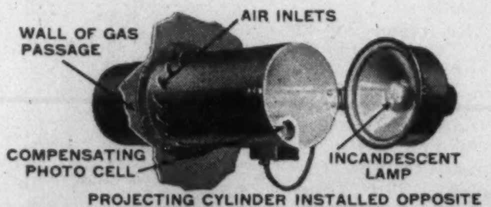
Metals & Alloys, June 1933.

Interlocked Braided Asbestos Packing

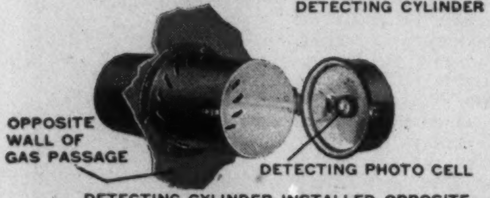


Johns-Manville, New York, N. Y., announces a new packing for reciprocating and centrifugal rods to be known as Interlocked Braided Asbestos Packing. Each individual strand of long-fibre asbestos yarn is so interlocked in the braiding as to provide for the first time a packing with a completely integral braided structure. There are no soft, heavy plaits to flatten; no jackets to wear through. Because it is braided square, rather than pressed into shape, it assures a better packing face on the rod, with more contacting area. The integral structure also results in greater resiliency and flexibility. J-M Interlocked Braided is recommended for packing against saturated or superheated steam; hot or cold, fresh or salt water; and weak caustics and acids.

New Smoke Recorder



PROJECTING CYLINDER INSTALLED OPPOSITE DETECTING CYLINDER



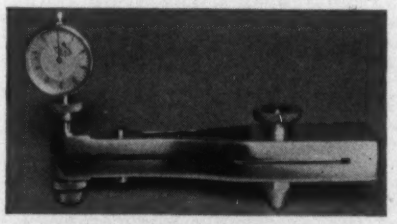
DETECTING CYLINDER INSTALLED OPPOSITE PROJECTING CYLINDER

A new photo cell smoke density recorder compensated for variations in light source intensity and operated by the Galvatron electronic relay circuit has been announced by Bailey Meter Company, Cleveland, O. This equipment consists of a recorder which is usually mounted on the individual boiler panel board and a transmitting element consisting of a projecting cylinder and a detecting cylinder which are mounted on opposite sides of the breeching or flue gas passage. A continuous record of relative smoke density is made by the recorder on a 12-inch uniformly graduated recording chart. This record clearly indicates stack conditions at all times, night and day, showing definitely each period of tube blowing. A hinged panel within the dustproof pressed steel recorder casing provides the chart plate on one side and on the other side an easily accessible mounting for the sensitive Galvanometer and Electronic Relays of the Galvatron. This Recording Galvatron is similar in many respects to the Bailey Galvatron Potentiometer Pyrometer. (See page MA 246, *Metals & Alloys*, May 1934 issue.) It will be noted from the accompanying illustration that two photo cells are employed in the transmitting element, one in the projecting cylinder and the other in the detecting cylinder.

New Shielded Arc Electrode

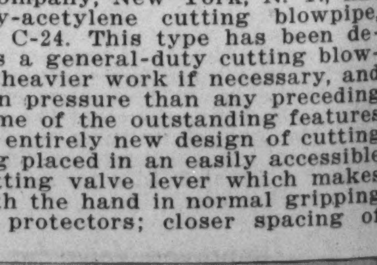
A general purpose heavily coated electrode for welding with the shielded arc on mild steel—Fleetweld No. 7—is announced by The Lincoln Electric Company, Cleveland, Ohio. The new electrode is designed particularly for high speed and single pass welding. Its arc characteristics are such that it is particularly suitable for welds where fit-up is apt to be poor. "Fleetweld No. 7" has a high burn-off rate and low splatter loss, providing exceptionally fast welding at low cost. The finished bead is smooth. Tests made on specimens of all weld metal show the following characteristics: tensile strength, 70,000 to 80,000 lbs./in.^{2}; yield point, 55,000 to 60,000 lbs./in.^{2}; elongation, approximately 20% in 2 inches; resistance to corrosion, greater than that of mild steel. In the ordinary arc the molten globules which pass from the electrode to the work are exposed to the ambient atmosphere which contains chiefly oxygen and nitrogen. The molten base metal is also exposed to these elements. They combine with the molten metal forming oxides and nitrides in the weld metal. If the metal during the fusion process is completely protected from contact with the ambient atmosphere the injurious chemical combination cannot take place. This can be achieved by completely shielding the arc. An arc may be shielded by completely enveloping it with an inert gas, which will not enter into chemical combination with the molten metal and at the same time prevent its contact with the atmospheric oxygen and nitrogen. Welds made with a completely shielded arc are largely free of oxides and nitrides and are therefore composed of metal having superior physical characteristics to that deposited by an ordinary arc. The development of shielded arc welding a few years ago had a tremendous effect in advancing and extending the use of arc welding. New fields were opened up, such as welding power boilers, ships, buildings, heavy machinery, and a host of applications which before were limited in extent. The coating on this rod is of special composition material, the metal drawn to rigid specifications, carefully selected and tested. The new electrode is manufactured in diameters of 1/8", 5/32", 3/16", 7/32", 1/4", 5/16" and 3/8" in 14 inch lengths. 1/8", 5/32" and 3/16" are designed for welding in flat, vertical or overhead position and larger sizes for welding in flat position only. "Fleetweld No. 7" is packed in square metal containers of 50 lb. size.

New Portable Brinell Tester



A new type of portable Brinell hardness testing instrument, which is being placed on the market by R. Y. Ferner Co., Washington, D. C., is adapted to the test of a wide range of hardness. It is designed for use in a drill press, an arbor press, on a lathe or planer, or in a vise or any other equipment by which the necessary pressures up to 750 kg. can be applied. The heavy spring formed by the 2 prongs of a tapered piece of steel is used as the means of measuring the pressure applied. A screw inserted in the end of the lower prong makes contact with the plunger of a dial indicator mounted in the other prong and can be adjusted and locked in position to give a zero reading on the dial with no load. A calibration of the instrument is furnished to show the readings of the dial corresponding to the usual loads of 750, 250, 187.5 and 62.5 kg. Balls of diameters of 2.5, 5 and 10 mm. mounted in holders for insertion in the under side of the lower prong are supplied with the equipment, and a Morse Cone holder and a square-shanked holder are supplied, in addition to the spherical knob used when the press is used in a vise. The complete outfit weighs only 5 lbs. A magnifier with cam-shaped dial for reading the diameters of impressions and their Brinell numbers is supplied with the instrument, or one of the usual Brinell microscopes can be furnished, if preferred.

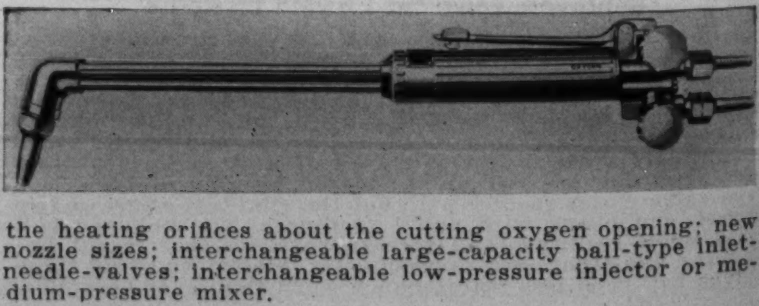
Micro Regulating Valve



The micro regulating valve of Hauck Manufacturing Company, Inc., Brooklyn, N. Y., is designed to assure close regulation, dependable resetting at all times and freedom from "fading away" and clogging troubles. The valve opening is an accurately and minutely variable orifice produced at a point where the rectangular slot in the cup-shaped portion of the valve plug meets the stationary, triangular opening in the ring seat. The area of this orifice is increased or decreased by minute increments as the valve plug is turned. This assures accurate regulation and control of flow with relatively large movements of the valve plug.

New Oxweld Cutting Blowpipe

The Linde Air Products Company, New York, N. Y., has just announced a new oxy-acetylene cutting blowpipe, known as the Oxweld Type C-24. This type has been designed essentially to serve as a general-duty cutting blowpipe, but is capable of doing heavier work if necessary, and will operate with less oxygen pressure than any preceding Oxweld cutting blowpipe. Some of the outstanding features of this new blowpipe are: an entirely new design of cutting oxygen valve, the valve being placed in an easily accessible position; a long external cutting valve lever which makes the valve easy to operate with the hand in normal gripping position; nozzles with seat protectors; closer spacing of the heating orifices about the cutting oxygen opening; new nozzle sizes; interchangeable large-capacity ball-type inlet-needle-valves; interchangeable low-pressure injector or medium-pressure mixer.

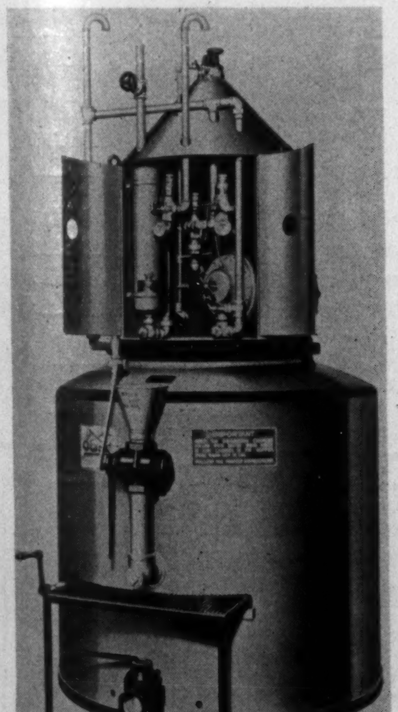


Pot Furnaces for Lead, Salt, Babbitt, etc.

Round-Pot Furnace with Three-Heat Snap Switch

Two new pot furnaces are announced by the Hevi Duty Electric Company, Milwaukee, Wis. One furnace is rectangular, the other is round. The furnaces are ruggedly constructed with an outer shell of heavy steel plate. The top plate is of ribbed alloy cast iron and securely fastened to the shell, being well insulated to prevent heat loss. Insulation consists of high and low temperature slab material of best quality which assures low radiation losses. Leaks to the furnace chamber are sealed off at the top of the pot by means of a sealing rope. The heating elements, helical coil type, are of heavy wire of high grade nickel-chromium, and are mounted in radiant refractories to reflect and radiate the heat to the furnace pot. Heat distribution is accurate and uniform resulting from the uniform distribution of heating elements around the pot. The three-heat snap switch, supplied on all sizes, permits high, medium and low input. Pyrometer control can be added to automatically maintain any desired temperature within the furnace range. These furnaces have the following advantages: 1. Uniformity in high quality production, 2. Uniform temperature, 3. Accurate temperature control, 4. Quick heating-up time, 5. Low initial investment, 6. Low operating cost, 7. Better working conditions and 8. Diversification of application.

New Stationary Oxweld Generator



The Linde Air Products Company, New York, N. Y., has announced another important addition to its acetylene generating equipment. This new automatic stationary generator, known as the Oxweld Type MP-5, is rated to deliver 1,000 cu. ft. of acetylene per hr. It is listed by the Underwriters' Laboratories, Inc. Its advent should be of great interest to users who want high capacity without operating two or more generators simultaneously. In general appearance it resembles the Oxweld Type MP-4 Portable Generator, announced in this issue of *Metals & Alloys*, with which it is identical in principle, except for size and slight changes to make it suitable for stationary use. Its compactness and efficiency show intelligent design in every detail. The feed is of the gravity type. The mechanism is of a most advanced design, unlike previously employed gravity feed devices. The feed control unit is self-contained and is bolted to the inside of the carbide hopper. The feed valve unit is actuated by a diaphragm. Pressure on the diaphragm is exerted by a housed and loaded spring unit. The spring is encased in a small housing and set at the factory to deliver about 13 lb./in.^{2} pressure. This can be changed within a range of about 2 lb./in.^{2} by an external adjustment. The set pressure feature does away with the necessity of setting the pressure when the machine is started. The pressure variation within the generator is not more than ¾ lb., and this variation is nullified in the service line by the built-in Oxweld Type R-57 Regulator. The carbide-charging door, the water-filling opening, the residue valve, and the handhole have been built on generous proportions so that time can be saved in emptying, recharging, and inspecting. The carbide hopper affords the greatest operating efficiency combined with easy cleaning; and the regulator filter unit, with its large capacity pads, is within easy reach inside the handhole. Instead of having an external hose connection manifold, it has the service valve which is necessary on a stationary machine on the service pipe that leads directly from the back-pressure valve. A funnel and a 3-in. lubricated water filling valve and vent cock take the place of a water-filling cap and overflow plug. The water-filling valve has an interference rod that operates the vent cock on a pipe leading to the outdoor vent line. This system makes it impossible to add water unless the cock is open to allow for the displacement of gas. The relief valve arrangement on the Type MP-5 generator is particularly interesting. A separate relief valve with a separate outdoor vent line is provided for the back-pressure valve, and two other relief valves with a common outdoor vent line are provided for the generator chamber. Two relief valves are used because of the high capacity of the generator, and also because it is easier to get good seating and prevent leakage when two valves are used instead of one large one. The Oxweld Type MP-5 Acetylene Generator is provided with a hopper that has eyelets around the top so that it can be removed with a block and tackle. Since a charging platform is usually built alongside a stationary generator, none has been provided on the new generator. To insure a gas tight seal and to lessen slaking when the generator is out of service for long periods, a soft rubber seat is provided on the hopper outlet. The hydraulic back-pressure valve and the reservoir are combined in one shell. The reservoir protects against accidental loss of water from the back-pressure valve and prevents water from backing into the regulator. An intermediate valve on one side of the hydraulic back-pressure valve and the service valve on the other make it possible to check the water level without escaping gas or loss of water. In general construction, this new generator has been made simple but rugged. Non-corroding materials are used throughout, and galvanized steel castings or stainless steel parts are used where exceptional strength is required. Most of the seams are bronze-welded; and some of the longer exposed joints on the water shell are double-vee welded, showing that no effort has been overlooked to make this of the finest and most permanent construction. Every detail has been planned either to eliminate the necessity for repairs or, where this is impossible, to make maintenance so easy that it will never be neglected or postponed. With the capacity it possesses, and with its simplicity and dependability of operation, there are few generators that can compare with it. It represents a new departure in stationary generator design and makes the use of generated acetylene more convenient than it has ever been before.

New Rust-Resisting Treatment

The Curtin-Howe Corporation, New York, N. Y., have placed a new rust-resisting treatment on the market. This treatment is called Loxal. The actual treatment consists of dipping the metal parts to be treated into the Loxal solution. About 10 ounces of Loxal Powder and 3 ounces of Loxal Solvent per gallon of water are dissolved in an iron tank. The parts to be treated are introduced into this solution in perforated iron baskets, on racks or by conveyors or trays, and are held in this solution for a period of from one to five minutes and are then given a quick rinse in hot water, after which they are dried in open air or a warm air blast. Little preparation is needed before treatment. Removing oil or grease and sometimes a brief pickling treatment, followed by rinsing in hot water usually suffices. The equipment required is inexpensive and requires practically no maintenance. A metal tank of requisite size, fitted with steam coils to heat the solution to 150°F. and with facilities for filling with water and for handling the material to be treated, is all that is necessary. Many advantages are claimed for Loxal coating. Iron and steel parts, cleaned by ordinary materials, are extremely susceptible to rusting after treatment and must be lacquered or otherwise finished within a few hours. This necessitates finishing such parts immediately after cleaning and involves an arrangement of shop schedules to accomplish this, which, at times, is both inconvenient and expensive. When metals are coated with Loxal, such parts may be stored without danger of rusting, until the manufacturer finds it convenient to apply the finishing coat. Loxal coating also acts as a bonding coat, presenting a uniform surface, free from blemishes, to which the finishing coat of paint, lacquer or enamel tenaciously adheres. Should any part of the base metal become exposed through a scratch or a break, Loxal coating will inhibit the spread of rust. Loxal is applicable to practically all types of iron and steel surfaces. The carbon content of the steel has no appreciable effect in retarding the formation of the Loxal coat, and excellent results have been obtained on steel objects which have been spot-welded or which carry an oxidized film on the metal surface. The same desirable Loxal coat can be formed on cadmium, zinc, and certain other nonferrous metals. Loxal gives a great coverage per pound of material and there is no appreciable loss as a result of precipitated sludge in the work-tank, since the addition of Loxal solvent to the bath converts any sludge into a clear solution which automatically becomes the active coating ingredient. A further economy is that iron equipment is not harmed by Loxal, and there is no danger of leaks occurring in iron tanks. As no chemical incrustation forms on the heating coils, whether made of iron or brass, highest heating efficiency is maintained.

The Climax Molybdenum Co. with main offices at 295 Madison Ave., New York City, announce the opening of two additional branch offices, one in Chicago, Ill. and the other in Canton, Ohio. The Chicago office is located in the Straus Building at 310 S. Michigan Ave. and is in charge of Mr. E. R. Young. The Canton office is located in the First National Bank Building of that city and is in charge of Mr. Paul M. Snyder.

Timken Breaks Electric Steel Record

The electric furnace department of The Timken Steel and Tube Company poured more steel in a month than ever before in the history of the company. The former record was 13,192 tons of electric furnace alloy steel in a month, but during May, 1934, the company poured 14,828 tons. This company record is likewise believed to be both a U. S. and a world record for electric furnace alloy steel production, and is more remarkable because of the rigid time requirements imposed on the melters to insure only quality steel production. Electric furnace production at the Timken plant has been 63,267 from January 1, 1934, as against 24,200 tons for the corresponding period in 1933.

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